Renter housing search behavior: Impact of the internet

Honors Thesis, Department of Economics

McKenzie Humann

Advisor: Anna Hardman

Reader: Yannis Ioannides

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Abstract

This thesis investigates renters' search behavior and how it has changed as a result of the emergence of online rental housing advertising. I use the national sample from the American Housing Survey (AHS) for 1999-2013 to determine which were the most successful search methods for renters and to what extent the internet has complemented or replaced traditional search strategies. The AHS is a dataset that has previously been overlooked in research on housing search behavior. House-owners' and renters' preferences are heterogeneous and the rental market is a matching market in which search continues until a satisfactory match is made. I investigate how the increased availability of online housing advertisements has impacted method of search used and the number of homes that renters visit during their search. I look at the number of units visited during search as a measure of efficiency in search. Contrary to my predictions, I find that renters' search intensity, conditional on search method, decreased after the creation of housing websites (such as Zillow, Trulia, Redfin and Realtor.com) for all renters except those that hired a real estate broker. This topic of renters' search behavior is surprisingly neglected in the housing economics literature and increasingly relevant within economic models of search and matching in the housing market considering the rise of the U.S. rental rate especially since the housing prices peaked in the late 2000s.

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1. Introduction

The heterogeneity of renters, buyers, and housing units is a salient characteristic of the housing market (Wheaton 1990). Renters and buyers alike overcome the state of imperfect information associated with this diversity by searching for housing units that best match their preferences and simultaneously are consistent with their budgets of time and money. In the last two decades, the growth of internet access (see Figure 17) has provided previously unavailable opportunities for renters and buyers to search for housing more easily and at a lower cost. Economists have explored the effects of online search for homebuyers: the share of homebuyers who used the internet, not necessarily exclusively, to search for a home increased from 34% in 2004 to 95% in 2016 (Young 2005, NAR Generational Report 2017).

Almost all economics literature that models search and matching in the housing market focuses solely on homebuyers. For example, only two paragraphs of the 73 page article on housing in the Handbook of Regional and Urban Economics (2015) address renters' search (The Microstructure of Housing Markets: Search, Bargaining, and Brokerage 2015). The few models that consider renters do so because they treat renting as a temporary, less desirable housing option for prospective homebuyers who move to new cities (Head and Ellis 2012, Kashiwagi 2014). However, the persistent share of renters in the US since the housing crisis in 2006 makes clear how unrealistic this assumption is. In 2015, the U.S. share of households who are renters 37%, the highest recorded rate in 20 years (ACS 2015 1-year survey).

How is renters' search different from homebuyers'? Furthermore, how has the growth of the internet impacted renters' search behavior? This thesis contributes to filling

the neglect in economic research on renters' search behavior. The topic of renters' search is increasingly relevant given the rise in renting and the growth of the internet in the U.S. Using data from the national sample of the American Housing Survey (AHS) for 1999-2013, I analyze how the emergence of online housing websites in the mid-2000s changed renters' search strategies and impacted how intensively renters search for rental housing. I formulate a simple model of the renter's choice of search methods. I then adopt Richardson and Zumpano's (2012) application of optimal search theory (OST) to model the renter's decision to search more or less intensively for housing.

In the past, most U.S. renters relied on advertisements or word of mouth to find housing (Krysan 2008). Advertisements included newspaper ads, magazine ads, radio ads, billboards, flyers or pamphlets, housing booklets, or 'For Lease' signs. Online advertisements are now included in that list. Since the late 1990s, local multiple listing services began digitizing their databases. In 1999, Craigslist.com started in San Francisco as a free service hosting classified advertisements online. It spread to other cities in the U.S. and continued to gain popularity throughout the 2000s. The early websites could provide more information about each unit's characteristics and even include photographs, surpassing the quality of print advertisements (See Figures 11 and 12 for photos of the Craigslist website).

The inauguration of Google Maps in 2005 further enhanced online housing advertisements. Shortly after Google maps went live, "mash-up" sites such as HousingMaps.com emerged. "Mash-ups" used Google maps to map Craigslist listings and provide geographical information to renters searching for units. By 2006, new websites like Zillow, Trulia, and Redfin had been created as alternative listing services to

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Craigslist and that offered this mapping function. Craigslist posts only include limited information, as the advertisers determine what information to provide. The later websites began providing information on a comprehensive set of unit and neighborhood characteristics, in addition to photographs and a map showing the unit's location. See Figures 13-16 for pictures of current popular housing listing websites. These new online housing listing services targeted both renters and homebuyers. In 2010, the National Association of Realtors (NAR) reported that Realtor.com, Trulia, Zillow, Yahoo, and local MLS sites were the top five places where real estate agents posted listings (MLS Technology Survey 2010).

My hypothesis at the start was that since 2006, the emergence of enhanced online housing listings has decreased the marginal cost of search for renters. Renters can now gather more information about rental units at a faster rate than they were able to do by using print advertisements or relying on word of mouth. The framework of optimal search theory states that search includes both search intensity and search duration. Search intensity is determined by the marginal cost of search. This is the costs associated with gathering information about and visiting an additional unit. I assume that after 2006 the majority of renters use the internet to search for housing to complement their other search methods. These renters faced lower marginal costs because the internet reduces the costs of gathering information for each additional unit. Thus, I expect renters' search intensity increased so that, on average, all renters visited more housing units after 2006, regardless of how the other search methods they used.

Other studies on housing search intensity have used data from the National Association of Realtor's Survey on Buyer's and Seller's Characteristics (Richardson and

Zumpano 2012, Genovese and Han 2012). That survey sample is limited to homebuyers, and suffers from selection bias both because survey responses are voluntary and because agents are not used in all transactions. As an alternative source of data, this thesis uses the national sample from the American Housing Survey (AHS) which has a large sample size, includes data on renters, and is a random sample of dwelling units. I look at the intensity as well as the mode of search used. This is an alternative approach to the common search model for owners, which is one that focuses on a homebuyer's or renter's reservation utility within a sequential search framework.

The remainder of the paper is structured as follows: Section 2 reviews existing search and matching theories for both the housing market and the labor market (where search modeling started), focusing on papers that explore the impact of the internet. Section 3 summarizes the most important features of the AHS 1999-2013 dataset and what I can learn about search using it: it traces the trends for search methods and search intensity by tenure and comparing the demographic characteristics of renters and homebuyers. Section 4 outlines the theoretical model I adopt to study the relationships between search intensity, search method, and household characteristics. Section 5 presents the results of the study and their significance. Finally, Section 6 concludes the study with a summary of the investigation, the implications for the role of intermediaries and search techniques in the rental housing market, and suggestions for future research.

2. Literature Review

This literature review is organized into the following sections: the search and matching theories with a focus on one-sided buyer search; an overview of optimal search theory and its application to the search for housing; the theoretical and empirical implications of using the as a search method within both the housing and labor markets; and a summary of the literature pertaining to housing search methods.

2.1 Search and Matching Theories

The theoretical and empirical research on housing search has focused on the housing market between buyers and sellers. Renters and landlords' search has been neglected. Thus, the following section refers only to homebuyers and sellers. The differences between search in owner and in rental markets and their implications are discussed at the end of this section.

The housing market is characterized by the heterogeneity of both homebuyers and homes. Homebuyers vary by their preferences and budgets; housing units are mainly distinguished by their characteristics, location, and price. Buyer preferences are impossible to observe and unit characteristics are costly to verify. As a result, sellers (or landlords) and buyers (or renters) have imperfect information, preventing easy, high quality matches between buyers and sellers (Wheaton 1990). Buyers and sellers search simultaneously for a suitable match according to their preferences. This search has economic costs: time spent searching, fees for gathering information, and the opportunity cost of the search efforts such as losing units that were previously visited (Carrillo 2012).

According to Wheaton's (1990) seminal paper on housing search, buyers search by gathering information on available units through advertisements. However, the advertisements never offer enough information for the buyer to decide whether or not he wants to purchase the home. The buyer must visit the unit in order to fully observe how well the unit fits the buyer's preferences (Wheaton 1990, Carrillo 2012). Search costs prevent buyers from visiting all available units even though this would allow them to find the best match (Anglin 1997). In models that recognize more than one matching criteria, buyers form an unobserved reservation utility criterion. The minimum criteria refer to the basic characteristics a unit must possess for the buyer to make an offer or accept the seller's price (Anglin 1997).[1] Thus, a match is made when a buyer visits a property that meets or exceeds her reservation criteria.

The process described above is a simple one-sided buyer search process. However, as previously mentioned, search occurs simultaneously between buyers and sellers (or landlords and renters). As a result, two-sided search models are thought to better estimate the relationships between search efforts and macroeconomic indicators such as housing prices, time on market and vacancy rates (Wheaton 1990, Genovese and Han 2012, and Carrillo 2012). Even though search is simultaneous, sellers usually rely on passive methods such as posting an advertisement and then waiting for buyers to visit their property. Buyers rely more heavily on active search methods to gather information and decide which units to visit (Carrillo 2012, Genovese and Han 2012) such as sifting through advertisements, online or in print. If increased levels of search effort increase the

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[1] This paper does not consider the different effects of bargaining, asking prices, or counter-offers on the matching process because of their limited relevance to the rental market.

likelihood of a match as in Wheaton (1990) and Anglin (1997), then the variation in levels of search reflect the buyer's active search process rather than the passive search efforts of the seller.

Head and Ellis (2012) and Kashiwagi (2014) have separately developed search and matching models that integrate the rental and sales markets for housing. Both model the rental market as frictionless relative to the housing market. As a result, their models suggest that when homeowners move they may choose to rent first until they find a "match", a satisfactory home to buy in their new location. Kashiwagi (2014) assumes that all households prefer to own rather than rent due to "psychological satisfaction and tax benefits." He recognizes that though some people may draw higher utility from renting because of the lower costs of moving or less responsibility of maintaining the unit. These reasons relate to the heterogeneity of agents (Kashiwagi 2014). Using data from the American Community Survey (ACS), Current Population Survey (CPS), and the U.S. Census Bureau, Head and Ellis (2012) confirm that homeowners are less mobile than renters. They speculate that the reduced mobility of homeowners has important labor market outcomes on wages and unemployment rates.

The focus on homebuyers in search and matching models reflect both parsimony and the historical predominance of owner-occupancy in the U.S. Many foundational aspects of the search and matching models described above intuitively also apply to renters' search. For renters as well as owners, properties and preferences are the heterogeneous. In both, imperfect information is endemic. Movers or potential movers gather information before visiting units until at some point they decide to rent or buy. Kashiwagi (2014) and Head and Ellis (2012) choose to distinguish the housing markets

for buying and renting by different levels of search frictions. In contrast, Benjamin (2015) emphasizes that buying a house is a more significant investment decision and holds higher risks in the event of a poor match than renting. These differences between renting and buying a home are reflected in how renters and homebuyers search for housing.

2.2 Search Methods

As mentioned earlier, the literature on housing search is dominated by homebuyer's search and often disregards any differences between buyers and renters search strategies. Traditionally, theoretical models on homebuyers' search behavior only recognized the buyer's use of advertisements or a real estate broker as search methods. Wheaton (1990) assumes buyers use only advertisements, while Anglin (1997), Baryla and Zumpano (1995), Elder et al. (1999), and Zumpano et al. (2003) recognize that most homebuyers hire real estate brokers to help find homes that match their preferences. The role of real estate brokers is a widely researched topic within housing economics. Han and Strange (2015) offer a thorough overview of why real estate brokers exist. Finally, in the last decade, studies of housing search such as Carrillo (2012), Piazzessi and Schneider (2014), and Genovese and Han (2012) have incorporated the use of the internet as a search method for homebuyers. These findings will be discussed in Section 2.4 Search and the internet. A complete compilation of all real estate listing websites is provided in Richardson and Zumpano (2012).

The NAR's Home Buyers and Sellers Survey has been the most widely used source for data on the search methods used by homebuyers. The survey has been

administered yearly since 1981 and offers the unique opportunity to track the search

trends of homebuyers. Other sources that homebuyers reported using include home books

or magazines, print newspaper advertisements, friends, yard signs/open house signs, and

home-builders or their agents. Figure 10 reports trends for all of these search methods

from 2001-2016 as shown in the NAR survey data.

The most recent analysis based on this data indicates that since 2001 buyers have

found their homes less frequently through agents and more frequently on the internet. In

2001, 8% of buyers first heard about the home they eventually bought from a website

while 48% of buyers learned through a real estate agent. In contrast, in 2016, 51% of

buyers heard about their current house from the internet and only 34% first learned

through a real estate agent (Riggs 2016). Despite this shift, 92% of homebuyers still hired

a real estate agent in 2017 (2017 NAR Generational Report). Zumpano et al. (2003)

investigates this changing role of the real estate agent due to the internet.

Though the NAR survey data has serious shortcomings, which are discussed in

the data section of this thesis, it does provide information on owners' search. Little search

data on renters was available until the emergence of online housing advertising. In

studies of racial differences, Krysan (2008) and Newburger (1995) use local survey data

from Detroit and Boston respectively to draw conclusions on the different search methods

used by both renters and buyers. Newburger (1995) argues that any differences between

search strategies used by whites and blacks disappear after controlling for tenure choice.

Similarly, Krysan (2008) finds that there is little difference between white and black

homebuyers.

Both studies confirm that renters rely on different search strategies than buyers; Krysan (2008) also finds that black renters in Detroit relied more heavily on informal networks than white renters. Renters used newspapers and the internet more frequently than buyers did, while buyers used yard signs, open houses, and real estate agents significantly more than renters (Krysan 2008). There was no significant difference in the proportion of renters and buyers who relied on friends or family members to find units; 21% of renters reported utilizing their social network was their primary search method. Only 13% of homebuyers reported the same. Forty percent of homebuyers said that they relied on professionals such as real estate brokers as their primary search method compared to 20% of renters. Though these patterns require further confirmation by using data from other cities, the reported differences between homebuyer's and renter's search methods are expected.

Krysan (2008) only uses data from 2004, and her research limits its focus to the role of online search; it cannot consider the technological improvements that have since enhanced housing listing websites. Kroft and Pope (2014) investigate the spread of Craigslist throughout the U.S. in the early 2000s. Their research confirms that internet search differs between renters and homebuyers. From 2005-2007, Kroft and Pope (2014) find that the MSA rental vacancy rates declined by 10% on average in the cities where Craigslist was available and widely used. However, this relationship did not hold for overall MSA vacancy rates or unemployment rates, indicating that the potential impact of Craigslist was highest in the rental market.

2.3 Optimal Search Theory

Buyers' search has been modeled with respect to both expected search costs and the buyer's reservation criteria within a sequential search framework (Anglin 1997). In this case, the buyer must choose both the optimal level of search: one maximizes the likelihood of finding a match; they also choose the reservation criteria that minimize search costs. Alternatively, Baryla and Zumpano (1999) model buyer's search using optimal search theory. The two choices facing the buyer are his search duration and search intensity. Optimal search theory combines sequential search and fixed-sample size search (Morgan and Manning 1985). Sequential search occurs when searchers draw a one-unit sample and observe the unit's matching quality before deciding whether to continue their search into the next search period. The alternative is a fixed-sample size which models searchers who observe a fixed number of units in one time period and choose the best from match from this sample. Under optimal combined search, the searchers determine both the sample size within a period and the number of periods they search. As a result, searchers then enjoy the flexibility of sequential search, avoiding unnecessary costs, and can take advantage of the speed of gathering information in fixed-sample size search (Morgan and Manning 1985).

In the context of housing search, optimal search theory thus defines search as occurring over two dimensions: search duration and search intensity (Baryla and Zumpano 1999). Search duration the total length of time spent searching and follows from implementing optimal search, with costs per limit of time. In housing search, across period costs are out-of-pocket costs of conducting search and the foregone utility due to delayed consumption of the good (Zumpano, et al. 2003). Search intensity is the total number of homes visited in a specified period of time. It is determined by the within-

period costs or the marginal cost of search. These include the costs of gathering information and the opportunity costs (time and money) of evaluating the unit (Zumpano et al. 2003). Buyers' search becomes a tradeoff between search duration and search intensity as they balance the costs of continuing their search with the costs of sampling (Zumpano et al. 2003). Several studies confirm the inverse relationship between search intensity and search duration in a homebuyer's search for housing (Baryla and Zumpano 1995, Elder et al. 1999, Zumpano, et al. 2003, Genovese and Han 2013).

Within this framework, buyer characteristics and their chosen search methods become important. They drive both the within and across period search costs. For instance, buyers who are moving to a new city or due to a job transfer have lower search durations and increased search intensity because they experience high across-period search costs (Baryla and Zumpano 1995, Elder, et al. 1999). Buyers who earn higher incomes and thus face higher opportunity costs for search are shown to search less intensively, but not necessarily for longer periods of time (Baryla and Zumpano 1995, Elder et al. 1999, Zumpano et al. 2003). Finally, since the use of real estate brokers is costly but reduces the marginal cost of search, buyers who hire brokers search for less time and more intensely (Baryla and Zumpano 1995, Elder et al. 1999, Zumpano et al. 2003, Richardson and Zumpano 2012). I expect that individuals with higher opportunity costs of time would more likely avail themselves of that option.

2.4 Search and the internet

A. E-Commerce

Though the housing market has several components that differentiate it from other markets, it is useful to briefly consider parallels to housing search on the impact of the internet on commercial goods. The internet has transformed the search process for homogeneous goods by eliminating the geographic aspect of markets and reducing search costs. These effects were expected to make markets for homogeneous goods more competitive by lowering prices and decreasing price variation across suppliers. However, early studies on e-commerce have recorded the opposite effects of increased price variation and slightly higher prices for goods bought online (Bailey 1999, Brynjolffson and Smith 2000, Baye et al. 2004). Ellison and Ellison (2014) argue that the slightly higher prices of used books sold online is accounted for by the higher quality of matches made between used book buyers and the books they buy. Thus, the effect of the internet on different markets needs to be evaluated not only in terms of price levels or price dispersion, but also through the arrival rate of matches and overall match quality.

B. Online Job Search

Given the similarities between search and matching models for the labor and housing markets, the literature on the effectiveness of online job search can offer particularly useful insights into search in the housing market. David Autor's (2001) seminal paper, "Wiring the Labor Market," extends the Diamond-Mortenson-Pissarides search model to predict how the growing use of the internet will change the job search process and the overall structure of the labor market. Autor (2011) posits that as the cost of the job search decreases with the use of the internet, the reservation utility for employers and workers increases because workers and firms can consider more potential

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matches at a faster rate. Under the assumptions of the Diamond-Mortenson-Pissarides model, this would ultimately lead to higher earnings as output increases and a reduction in unemployment levels. Recent empirical research confirms that workers who searched for jobs online obtain higher wages, though the differences remained relatively small after correcting for selection biases (Shahiri and Osman 2015).

Due to the relative ease of applying to jobs on the internet, open positions will receive massively more job applicants from which hiring managers must then screen and choose (Autor 2011). The application process online no longer serves as a valuable signal to hiring managers that applicants are serious about the advertised position. Consequently, Autor (2001) predicts that the role of the labor intermediation market will become more important as indicators of worker quality. Word of mouth recommendations and personal referrals will also become increasingly important. Ioannides and Loury (2004) and Calvó-Armengol and Zenou (2005) investigate the role of social networks in the search for employment. These are important forecasts that can be applied to the rental housing market. They raise questions about how the rise of the internet has shifted the role of real estate agents and personal referrals within renter's search for housing.

Though earlier research suggests that online job search increases search duration (Kuhn and Skuterud 2004), more recent investigations provide evidence that internet searchers' experience shorter unemployment durations than similar workers who search offline (Kuhn and Mansour 2013, Fountain 2005). Kuhn and Mansour's (2013) more recent study uses National Longitudinal Survey of Youth data from 2005-2008, which is consistent with Autor's (2001) theoretical predictions. They find that the internet reduces

search frictions and consequently increases the rate of matches between those seeking a job and open positions. Their results indicate that unemployment durations of job seekers are reduced by 25% when they search online. They speculate that online search became more efficient due to technology improvements such as better online job sites and growing networks installed since the initial research. These results are important for evaluating the impact of the internet on housing search: the most widely used housing advertisement websites such as Trulia, Redfin, and Zillow only emerged in the second half of the 2010s.

Job match quality can also be evaluated in terms of worker's satisfaction. Mang (2012) uses data from the German Socio-Economic Panel to evaluate whether those who used the internet in their job search are more satisfied with their job across a range of categories. Overall, online job seekers were more satisfied with their new jobs: they reported that they were using their skills better and had a higher chance of receiving a promotion. These assessment criteria can be considered to be 'high-bandwidth information' since they are characteristics of the job that are difficult to predict or verify without investing significant time or research efforts (Autor 2001). The majority of the desired criteria of a rental unit can be considered to be 'low-bandwidth data' since characteristics included in online listings are easily verifiable through a personal visit. This comparison suggests that there is an even greater potential for improving match quality by utilizing the internet in housing search.

C. Online Housing Search

The use of the internet, directly or indirectly, in home searches increased from 30% of buyers in 2003 to 99% of buyers in 2016 (Richardson and Zumpano 2012, NAR 2016 Survey of Home-Buyer Characteristics). Observing this trend, economists have incorporated the role of the internet in recent search and matching theories of the housing market, recognizing it as a primary search method that has reduced search frictions. The scope and increasing availability of internet search data have also allowed economists to consider how search is segmented by location, preferences, and prices (Piazzesi et al. 2014).

Within search theory, the internet is treated as a new technology replacing older technologies (such as newspaper advertising). It allows buyers to gather more information about units before deciding which units to visit and thus shifts the distribution of potential matches (Genevose and Han 2012, Lester et al. 2016, Carrillo 2016, D'Urso 2002). Though the online advertising technology remains exogenous to search, the capability to search postings by selected characteristics produces endogenous matching (Carrillo 2012). Within the owner market where real estate agents are still widely used, the internet may serve more as a search method that both replaces the traditional method of looking at newspaper advertisements and complements the strategy of hiring a real estate agent (Zumpano et al 2003).

Carrillo (2012) provides the most recent and robust model for understanding the impacts of the internet on housing market outcomes. Drawing on the assumptions within Wheaton's theory of search and matching where buyers can only confirm matches by visiting the unit, Carrillo (2012) finds that more than half of the buyer's evaluation of a unit is determined when the buyer views the online listing. The rest of the match is

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revealed when the homebuyer visits the home. At the same time, Carrillo (2012) calculates that only 3% of the "idiosyncratic home-buyer match value" is observed from the information in the listing. However, this percentage increased each year in his data, from 2000-2002, due to the addition of features such as virtual tours and photos to the online listings. Carrillo (2012) draws three important conclusions from his investigation. Firstly, he expects online housing advertisements to improve as more technological constraints disappear. His predictions have since been confirmed. For example, the debut of Google Maps in 2005 allowed housing advertisements to include a map-feature that provides more information on the unit's location and surrounding amenities. These enhancements have important market outcomes as Carrillo (2012) determines that additional online information causes market prices to decrease and seller's time on the market to increase.

The internet allows searchers to gather more information, more easily. It thereby reduces the marginal costs of search. Under optimal search theory (OST), this reduction in the marginal costs of search increases search intensity and decreases search duration. Richardson and Zumpano (2013) confirm the prediction that searching on the internet increases search intensity; they observe that homebuyers that used online listings visited more homes on average in one week than did homebuyers who were not using the internet. Likewise, Genovese and Han (2012) find that homebuyers that used the internet physically looked at more units total during their search. However, Richardson and Zumpano (2013) only observe this increase in data from 2009, but not in 2006. They conclude using the internet increased buyer's search intensity, but only in housing markets that were favorable to buyers such as those that followed the 2008 housing crash.

Despite the proposed inverse relationship between search intensity and search duration within OST, empirical research consistently indicates that internet use lengthens the housing search for buyers. In an early study on internet use, D'Urso (2002) calculates that homebuyers using the internet rather than the conventional method of search would increase their time searching by 2 weeks, or by 25% at the median length of search. Genovese and Han (2012) similarly find that if all homebuyers searched online, average 'buyer time on the market' would increase by 24%.

Likewise, Richardson and Zumpano (2012) reach comparable conclusions and question whether the internet is making search more efficient. They speculate that as the more housing information available via the internet increases, homebuyers are unable to process all of this information and in fact face rising information costs. In a similar vein, Rae and Sener (2016) acknowledge how the internet has "undoubtedly lowered search frictions," but question whether it has led to more desirable outcomes for movers.

Though economists previously recognized that location was an important element of search, the lack of spatial data has limited the extent to which research could pursue questions about geography and neighborhood preferences within search. As Alonso (1960) pointed out, a home purchase contains both the physical unit and the unit's location. Geography captures preferences for commuting costs, access to schools, neighborhood crime rates, public transportation access, and other neighborhood amenities (Dunning and Grayson 2014).

Though the topic of how renters search spatially is beyond the scope of this paper, it is interesting to acknowledge how online housing listing search engines have potentially transformed the way that homebuyers and renters approach the search process.

Dunning and Grayson (2014) claim that "users are pushed to simultaneously think spatially and sectorally since online real estate portals lead users to specify multiple attributes on geography." Rae (2015), Rae and Sener (2016), and Piazzessi et al. (2014) have similarly acknowledged how housing search engine websites encourage movers to search specifically by location.

3. Data

This thesis uses data from the national sample of the American Housing Survey (AHS) from 1999 to 2013. The survey is administered every two years in the odd-numbered years. Eight of these surveys are included in this analysis. Conducted by the U.S. Census Bureau, AHS is a longitudinal survey of a nationally representative sample of the U.S. housing stock. It asks the occupants questions on both housing and household characteristics. The same sample of housing units is surveyed every two years and is updated every two years, adding newly constructed units and removing demolished units accordingly. The AHS conducts surveys for national and metropolitan samples that are designed to be representative accordingly.

Previous investigations on housing search use data from the National Association of Realtors Survey on Buyer's and Seller's Characteristics (NAR). In comparison, the AHS provides data on both renters and homebuyers while the NAR data is limited to only homebuyers. Furthermore, the NAR sample size each year is much smaller than that of the AHS. Finally, the NAR data suffer from selection bias, as the survey is voluntary and limited to homebuyers who used real estate brokers in their search. For these reasons, I chose to use data from the AHS on renters' housing search. In doing so, I provide a fresh look at renters' and homebuyers' housing search behaviors as this section of the AHS has never been used for such an investigation.

From 1999-2013, the average sample size of the AHS was 66,170 households. An average of 32% of those households were renters. Table 1 shows the sample size of each survey year, the number of renter-occupied units, and the percentage of renter-occupied units within the respective sample. In 2011, the AHS conducted both the Metropolitan

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and National surveys in the same year. The Metropolitan survey data from 2011 was included in this investigation. However, in future investigations it will be important to distinguish between the National and Metropolitan samples.

The sample size for the 2011 survey is 2-3 times as large as the sample sizes from the other survey years. Moreover, renter-occupied units were a larger proportion of the sample in 2011 in comparison to previous years: 36% in 2011 compared to 30% in 2009. Before 2011, the fraction of renters in the AHS sample was always 3-5 percentage points lower than the fraction of renters in the U.S. as estimated by the ACS 5-year surveys. However, the increased proportion of renters surveyed in the 2011 and 2013 samples of the AHS better reflect the increased number of renters in the U.S. after the housing bubble burst in 2006 (Joint Center for Housing Studies 2006).

The AHS distinguishes surveyed households by recent movers or households that have lived in the same unit for an extended period of time. Recent movers are households that moved into their unit within the last two years of when the survey was administered. Only recent mover households are asked about what search method they used and how many homes they visited during their search as will be discussed later in this section. The data that I use to model search method and search intensity choices are limited to recent movers.

3.1 Renters' vs. Homeowners' Characteristics for Recent Movers and Non-Movers

Though the main topic under examination in this paper is renters' search behavior, Tables 2-4 summarize the basic characteristics of all respondents of the AHS and for recent movers by tenure. They identify the differences between homeowners and

renters because most of the housing search literature only focuses on homeowners. Recent movers within these groups differ from the population. The average age of renters, 43.8 years, is 10 years lower than the average age of homeowners. Both homebuyers and renters who had recently moved when the survey was administered were on average younger than the corresponding group in the whole sample. Homeowners are only slightly more educated than renters with 13.92 years of schooling compared to 13.04 years. However, there is no significant difference between the educational attainment of the total sample and that of the recent movers. Both for recent movers and for all respondents, homeowners earned on average twice as much income as renters. This is unsurprising since homeowners are generally older and more educated than renters. Homeowners have an income that would allow them to finance a home purchase.

The marital status and household relationships show similar patterns when I compare recent movers and all respondents. However, the percentage of renters who are married, 27% for recent movers, is less than half of the percentage of homeowners who are married. Moreover, a higher percentage of renters have never been married compared to homeowners. Finally, renters exhibit roughly a 1:1 ratio of those living with relatives vs. those living with non-relatives while this same ratio for homeowners is 3:1. The differences noted between homeowners and renters and between the total population and movers are confirmed in Head and Ellis (2012) and in reports using data from the American Community Survey.[2]

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[2] The Joint Center for Housing Studies' report on the demographics of renters titled, "America's Rental Housing: Meeting Challenges, Building on Opportunities" for a more detailed analysis of the differences between renters and homeowners. Also see "Young Adult Migration: 2007-2009 to 2010-2012" (Benetsky, Burd, and Rapino 2015) for an in-depth look on the demographic trends of young movers.

3.2 Search Strategy and Search Intensity Trends: Homebuyers and Renters

From 1999-2009 AHS asked respondents to indicate which option of five possible answers best described the method through which they first heard about their current housing unit. These options were advertisements, real estate broker, sign on property, friend, or other. In 2011, the questionnaire changed and the available answers expanded to include twelve possible options total. The most noticeable additions to this list of search strategies were internet sources such as Craigslist, Realtor.com, or ad on a different website that previously would have been considered to be in the vague category of "advertisements". Since the respondents were only allowed to choose one answer option in the survey, the data do not record all of the search strategies that each respondent used during his search. Furthermore, the survey question asks only about how the mover first heard about the housing unit, though respondents may also have used other search strategies for other aspects of the search. Table 2 presents the possible answers for both time periods and indicates how I recoded the data from the 2011 and 2013 surveys to fit the previous answer options.

Table 6 presents the composition of search strategies for renters and owners averaged across the 14-year span and shows that renters and buyers rely on different strategies for finding a new place to live. Nearly 30% of homebuyers during this time period found their homes through real estate brokers. This share is lower than that reported in corresponding NAR surveys on homebuyer's search (see Figure 10); the difference is potentially due to the selection bias in the NAR survey data since the survey is voluntary and has a low response rate. Despite these pitfalls, NAR survey results are frequently used as data in research on homebuyers' search. This AHS data challenge

previous assertions about homebuyers' search and the assumed role of the real estate broker.

The second and third most used sources for homebuyers were advertisements and word of mouth, recording 21.6% of homebuyers in each category. In comparison, roughly 40% of renters reported first hearing about their current housing unit through word of mouth and 29% reported using an advertisement. Only 4% of renters reported finding their current unit through a broker from 1999-2013. The portions of movers who learned about their homes through signs on the building or the "other" category are similar for both renters and homebuyers. The gap in the use of brokers by renters and by homeowners is not surprising given the lower levels of investment and legal risks associated with renting compared to buying a home (Benjamin et al. 2005).

The popularity of word of mouth as a consistent source for renters to learn about available units for lease is surprising and suggests how important social networks are in the search process. Given that the data report only successful searches, it suggests that relying on friends and family in housing search is the most successful method. However, it is a search strategy that is limited to renters who have strong social networks in the area where they are searching. Renters who are moving to different cities most likely do not have the same opportunity to rely on their friends and family when looking for housing.

These search tendencies do not remain constant during this time period for either renters or homebuyers. See Figure 1 for renter's search strategies and Graph 2 for buyer's search strategies graphed across the 14-year span. For both renters and buyers, there is a noticeable shift across nearly all categories in 2011 due to the larger sample size that includes more units from metropolitan areas in comparison to the other survey years.

Additionally, though I have recoded the results from the 2011 and 2013 survey responses, the questionnaire changes could also have contributed to the dramatic trend shifts. However, for all categories except renter's word of mouth, the trends persist in the 2013 data and so there is little reason to believe that the recoding is an inadequate strategy for comparing the 1999-2009 and 2011-2013 results.

Considering buyers' search strategies first, brokers remained the most frequent source for buyers until 2011, at which point advertisements became the most cited source. In this 14-year span, the percentage of homebuyers who found their new home dropped by 10 percentage points while the percentage of homebuyers who heard through advertisements increased by nearly 20 points. This impressive switch supports recent research that indicates the role of the real estate broker has been changed by the internet. While the majority of homebuyers continue to use real estate agents, they increasingly rely on search through the internet to find potential homes (2017 NAR Generational Report). The intermediation role of real estate brokers has evolved within the homebuyer search process to focus mainly on arranging home visits, ensuring proper inspections, and helping to organize the legal and financial components of the transaction (Zumpano et al. 2003).

Renters' search strategies did not undergo as dramatic a change. For renters, word of mouth remained the most frequently used method of search during the time span, though it exhibits a slight decline. Advertisements remained the second most frequently cited source. From 1999-2005 it appears that the role of advertisements was slowly declining, but from 2007-2013 the percentage of renters that used advertisements rose again to the same level as in 1999. The trend reversal of advertisements could be due to

the housing listing websites that premiered halfway through the 2000s and which would be considered advertisements. Unfortunately, the data do not reveal which types of advertisements renters used until the questionnaire changes in 2011. Even though the advertisements trend-line does not exhibit any dramatic patterns, the composition of advertisements is presumably changing during the time period such as through a decline in the use of newspaper listings or an increase in the use of online advertisements. Finally, both the use of a real estate broker and a sign on a building steadily declined during the period, while the other category increased by nearly 8 percentage points. This increase is puzzling since it occurs when the questionnaire changed to include more options; the inclusion of more specific answer options would lead one to think that the 'other' category would be marked less frequently.

When I recoded the data from 2011-2013 to fit the original answer options, the changing percentages of renters and owners who used each search strategy can be seen clearly in Table 13. This data shows which types of advertisements renters and owners rely on during their search. Online advertisements were used more frequently by homebuyers (roughly 30%) than by renters (roughly 20%). Renters who used online advertisements tended to search on Craigslist or a different website while roughly 20% of homebuyers used Realtor.com. Finally, nearly 10% of renters used more traditional advertisements such as newspapers in comparison to 3.5% of homebuyers.

3.3 Descriptive Statistics

The main variables under examination fall into two groups: householder characteristics and characteristics of the householder's most recent move. The

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householder characteristics include income, age, and educational attainment. Meanwhile, the moving characteristics also refer to: if the respondent moved into an urban area, whether or not the respondent was forced to move out of their previous accommodation, whether the respondent had to move for a job transfer or a new job, how the respondent first heard about his current housing unit, and how many units the respondent visited during her search.

Tables 7-9 present summary statistics for educational attainment, age, and income of respondents for each survey year and limited to only renters. Educational attainment is measured by years of school. Income is the respondent's estimated income from the year preceding the survey year. During the time period, the average income and age of renters increased while years of schooling remained stable. When these statistics are computed by search strategy, similar patterns immerge however they are more pronounced for different search methods. Figures 4-6 show the box and whisker plots for each search strategy for each survey year for renters from 1999-2013. Most notably, the median income values of renters who used real estate agents or advertisements increased throughout the period while the interquartile ranges noticeably expanded. Likewise, the interquartile age ranges for renters who used word of mouth or other search methods also spread out. Since income shows the most variation among search methods, I utilized the more specific data from 2011 and 2013 to see how the median income level and the interquartile ranges differ by the twelve search options offered in the expanded search strategy question. Graph 7 shows these results; interestingly, those who used internet websites (Craigslist, Realtor.com, or an ad on a different website) earned more than those

who used other types of advertising such as weekly or daily newspapers, billboards, or radio ads.

Though Table 10 shows that the number of units looked at during search increased by 9% from 1999-2013, Graph 7 shows how the average search intensity varied by search methods throughout the time period. Renters who hired brokers search more intensively than those who use other search methods as well as increased their search intensity by the greatest margin throughout the period. The trend-lines for Advertisements, Word of Mouth, and Other also display slight increases in average number of units looked at during the renter's search. See Section IV for an explanation on how search methods determine renter's search intensity. The maximum number of homes looked at during the search process is 99 for each survey year because the surveyors could only report two digits worth of information.

Finally, Table 11 displays the average percentage of renters that moved for a job transfer (10.32%), were forced to move (15.77%), or moved into an urban area (89.7%). See Table 12 for the AHS's list of reasons for moving and which reasons were considered to be forced moves. Table 13 presents the correlations between all of the variables and the search strategies.

3.4 Urban Status

Urban movers heavily dominate this dataset: 89.7% of renters moved into urban areas in this sample. See Graph 2 to understand how the composition of search strategies differs between renters in urban areas and renters in rural areas. Word of mouth is significantly more popular among rural renters than urban renters, though the difference

decreases throughout the time period. Meanwhile, using advertisements is consistently

more popular among urban renters. The remaining search methods follow similar patterns

for both urban and rural renters. Surprisingly, there is nearly no difference in the use of

real estate brokers between urban and rural renters. One would expect urban renters to be

more inclined to use a real estate broker in order to reduce the higher search costs of

finding housing in a city.

4. Model

4.1 Theoretical Model

In this model, renters looking to move into a new unit have to make two decisions in order to search: which search method (or methods) to use and how intensively they will search. In their search, renters want to maximize their expected utility derived from their future home based on their preferences conditional on rent. This utility depends on the value they will derive from occupying the dwelling unit, discounted due to the true occupancy plus the expected costs of search. In this case, search efforts correspond to search intensity. According to optimal search theory, search intensity has an inverse relationship with time spent searching, or search duration.. Given these goals, renters choose the search method they think will help them to find the unit that will best fit their preferences and that will require a balance between search efforts and search length. After choosing a primary search strategy, renters decide how intensively they will search.

Optimal search theory provides a useful model of the relationship between the time spent searching and search effort (Morgan and Manning 1985). Search has two dimensions: search duration and search intensity. As mentioned above, ex ante these two dimensions will have an inverse relationship with each other. Search duration, determined by the across period cost of search, is typically measured by total time spent searching. Search intensity is determined by the within period costs or marginal costs of search and is measured by number of units visited in a specified time period.

Based on these assumptions in this thesis, I test the hypothesis that the emergence of online housing advertising websites in 2006 has increased search intensity for all renters. The amount of information available to renters via websites such as Zillow,

Redfin, Trulia, Craigslist, etc. has greatly increased and easier to access than before 2006. Given this shift, the marginal cost of gathering information has decreased resulting in a predicted increase in search intensity which will be reflected in the higher number of units visited. I expect that this increase will be observable across all of the search strategies because I assume that renters are using these websites to complement their other modes of search. Finally, based on previous research by Elder and Zumpano (2003), I expect that the increase in search intensity will be greatest for renters who hire real estate brokers. It will also be greater for renters who use advertisements since housing websites are a subset of advertisements in the data.

4.2. Empirical Model

I use two steps to estimate the joint decision of search method and search intensity. I first estimate a multinomial logit regression model of the renter's choice among the five basic search strategies reported in the AHS (Table 5). Then I estimate search intensity conditional on the choice of search method. The multinomial logit regression is specified as:

$$\eta_{ij} = \log\frac{\pi_{ij}}{\pi_{iJ}} = \beta_0 + \beta_1 After06_i + \beta_2\, Urban_i + \beta_3\, logInc_i + \beta_4\, Age_i + \beta_5\, AgeSquared_i$$

$$+ \beta_6 Educ_i\ + \beta_7\, JobTransfer_i + \beta_8\, ForcedMove_i + \Sigma\delta_t T + \varepsilon_{ij}\ ,$$

$$(1)$$

where η_{ij} is the log probability that j search strategy will be chosen instead of the base outcome J by household i, and ε_{ij} is extreme value distributed.

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The base outcome in this regression is the 'Other' category of search. The explanatory variables include: a dummy variable indicating whether or not the survey was administered after 2006, a dummy variable indicting whether the renter moved into an urban area, the renter's (log of) income, renter's age with a quadratic term, the renter's educational attainment, a dummy variable indicating whether the renter moved for a job transfer, and a dummy variable indicating whether the move was forced. I also include time fixed effects to control for any influential events that would have shifted the choice of search strategies in a given year.

Since the use of the 'Other' category increased the most during this time period (see Graph 1), I expect the coefficient on *After06* to be negative across the four remaining search strategies. However, I also expect that the values of the negative coefficients will vary by search method because they each exhibited a unique trend-line in Graph 1. I predict that *Urban* will exhibit a positive relationship for prediction of the use of a real estate broker because it is costly to a mover to gather information on the more and varied neighborhoods of an urban area without the expertise of a real estate broker. Furthermore, I expect that *Urban* will have a significant positive relationship with the use of signs on buildings. Since urban areas have higher building density than rural areas, city dwellers are more likely to see "For Lease" signs in urban areas than in rural areas. Finally, the relationships between *Urban* and using advertisements or word of mouth are indeterminate.

Because real estate brokers charge fees for their services, I expect the probability of hiring a real estate broker to increase as *logInc* increases. The relationships between income and the other modes of search are unclear. With regard to age, I expect younger

renters to be more likely to utilize the online housing advertisements that are increasingly available during this time period. At the same time, older renters could be expected to stick to traditional methods of search such as newspaper listings that are also considered to be advertisements. Thus, the relationship between age and the likelihood of using advertisements is unclear. I expect that older renters will be more inclined to hire real estate brokers, as it is the more traditional search method. There is no clear intuition for how age might affect the use of signs on buildings or friends as search methods.

Well-educated renters are expected to take the initiative to seek out active modes of search such as hiring real estate brokers or reading advertisements. Renters who have attained high levels of education are also more likely to appreciate the expertise of a real estate broker. Signs on buildings and friends are more likely to be used by renters with less education because they are passive modes of search.

The *JobTransfer* variable is the only indication in the AHS data for if the renter moved from a different city. I use it as a proxy for large distance searches. Signs on buildings and friends are expected to be used less frequently by renters moving because of a job transfer because I assume the renter will have spent less time in the new city, decreasing the likelihood that they have seen a 'For Lease' sign, and will know fewer people in the new city. Renters moving for a job transfer are thus more likely to resort to hiring a local real estate agent or searching through local advertisements since these methods can be conducted remotely. Finally, renters who are being forced to move are expected to choose active methods of search such as advertisements or hiring a broker because they need to quickly find new housing units.

In the second stage, I estimate search intensity conditional on search method chosen by using a conditional mean correction. The regression with search intensity as the dependent variable is then:

$$\log SI_i = \beta_0 + \beta_1 After06_i + \beta_2\ Urban_i\ \beta_3\ logInc_i + \beta_4\ Age_i + \beta_5\ AgeSquared_i + \beta_6\ Educ_i\ +$$
$$\beta_7\ JobTransfer_i + \beta_8\ ForcedMove_i + \Sigma\beta\ IntTerms_i +\ E[SI_j\ |\pi = \pi_j] + \Sigma\delta_t T + \Sigma\delta_k MSA$$
$$+\ \phi_{ij}\ ,$$

(2)

where ϕ_{ij} is independently and identically distributed across individuals and $E[SI_j\ |\pi = \pi_j]$ is the conditional mean correction associated with a discrete choice model. This correction was developed by Dubin (1985) and was first used by Dubin and McFadden (1984). I follow the method outlined in Appendix B of Ioannides and Zabel (2008) and compute the correction terms using the estimates of the multinomial discrete choice model, Equation (1). Note that this correction functions like an instrument and the estimated coefficients of the error correction terms are not particularly meaningful and are therefore not reported. Equation (2) includes the same set of variables in the choice of search method, a set of interaction terms between the renter and move characteristics and *After06*, time fixed effects to control for yearly variations and random effects to capture variations between MSAs. Search intensity is measured by the log of the number of homes looked at during the renter's search for housing.

According to OST, search intensity is a measurement of search efforts in a specific period of time. Unfortunately, the AHS does not ask recent movers for how long they searched, which could be used to calculate the average number of homes that renters

looked at in one week of their search. This is how search intensity is measured in other studies on housing search behavior of homebuyers (Zumpano and Richardson 2011; Zumpano et al. 2003; Elder et al. 1999). However, in comparison to homebuyers, renters look to move are more likely to have a predetermined length of search because they must vacate their current unit by the time their lease ends. Though some renters may find their new units sooner, most have a fixed upper time limit for finding a new unit. Thus, there is likely less variation in search duration for renters than for homebuyers. I can then assume that the total number of units visited by renters is an adequate measurement of search intensity. If search duration is fixed, search intensity becomes the more relevant measurement of the intensity of search.

Renter's income serves as a proxy for the opportunity cost of search. As income increases, search intensity is expected to decrease. As renter's grow older, they learn to search more efficiently from their past experiences; I expect age to have a negative relationship with search intensity. However, this learning effect captured by age could be more impactful at younger ages as older people have fewer things to learn about the rental market. The quadratic term is included to account for this potential non-linear relationship between age and search intensity. Additionally, the elderly may be less mobile and unable to visit as many units as younger movers. Similar to age, more educated renters are expected to learn while searching. Though this learning effect is expected to make search more efficient, it is unclear whether it will decrease search duration or search intensity as a result.

Renters moving for a job transfer must travel to their new city to visit units that are available to lease. Within optimal search theory, this increases the across period costs

of searching thus decreasing search duration and increasing search intensity.

Additionally, the soon-to-be employers as well as the movers experience the high

opportunity costs for prolonged housing searches, further encouraging more intensive

search. Likewise, I expect renters who are forced to move are likely to search more

intensively because of the urgency of finding a new place to live in the shortest amount of

time.

5. Results

5.1 Search Methods

The multinomial regression results that estimate the probability of choosing each search method are presented in Table 14. Each column displays the coefficients related to the probability of choosing the specified search method instead of the base outcome which is the 'other' category. Many of the variables vary with the search strategy choice, though which variables are significant differs by search strategy. It is important to remember in considering these results, that the coefficients indicate how the respective variable impacts the decision for renters to choose between the given search method and a search method that would fall into the 'other' category. For instance, since the percentage of renters who indicated they found out about their current housing unit by the 'other' search method increased the most during the time period, it is unsurprising that the all of the coefficients for *After06* are negative. The same trends for the renter's choice of search strategy as discussed in the data section hold true; holding everything else constant, renter's were 75% ((exp(-1.409)-1)*100) less likely to learn about their housing unit through a broker and 52% less likely to have seen a sign on a building than through a different, unspecified search method after 2006.

The impact of searching in an urban area behaved as expected with regard to the use of signs on buildings. Renters were 21% more likely to use a sign on a building than an unspecified search method in an urban area. Signs are more efficient advertising tools for landlords or owners when more people are prone to pass by the area. This is more often true in cities but not guaranteed in rural areas. Meanwhile, renters were 29% less likely to first hear about their current housing unit through a friend, confirming the trend

in Figure 3. Though the marginal effects for *Urban* are significant for hiring a broker and using advertisements, their predicted probabilities are small in magnitude, which are 3% and 0.6% respectively. The results do not confirm the intuition that renters searching in urban areas are more likely to hire real estate brokers.

Age exhibits a quadratic effect with both hiring a broker and seeing a sign on a building. The likelihood that a renter learned about his current housing unit through a real estate broker instead of an "other" or unnamed search method increased until the renter was 40 years old, at which point that likelihood began to decrease. Similarly, the likelihood that renters looking to move saw a sign on a building increased until age 36 and then began to fall. Age exhibits a negative linear relationship with renters who learned through a friend, indicating that older renters looking to move were less likely to learn about their current units through word of mouth than younger renters. However, these likelihoods did not change greatly for renters that were younger and older than the respective peak ages. Meanwhile, the likelihood of using advertisements and friends decreased as the renter's age increased.

As expected, the higher income earners were more likely to hire real estate brokers; a renter that earned 1% more income than a different renter with the same characteristics was 42% more likely to hire a broker than to find their housing unit through a different, unspecified search method. In an equivalent situation, renters were only 20% more likely to find a home through advertisements and 15% more likely to have learned about their current housing unit through a sign than through a different search method not mentioned in the survey. The results for educational attainment follow a similar pattern. Renters who have one more year of education are 13% more likely to

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hire a broker or 9% more likely to have found their unit through advertisements than through a search method that falls into the 'other' category. More educated renters might prefer to hire a broker to assist with their search because the broker can offer specialized information about the search process and available units within the area. Meanwhile, renters were slightly less likely to have seen a sign on a building or learned through a friend if they were more educated.

Renters who moved because of a job transfer were 45% more likely to have found their new rental unit through a real estate broker than through a different search method. Again, the broker's specialist knowledge about the housing search is especially useful to someone who is moving from a different city which is more likely the case for the renters who moved for a job transfer. Real estate brokers can provide information about the city neighborhoods that the renter would otherwise not learn easily. Additionally, employers that pay to move their employees for the job transfer may subsidize the cost or hire a broker on the employee's behalf to expedite the process. Holding all other characteristics constant, renters moving for a job transfer were 18% more likely to learn about their current unit through advertisements than a method in the 'other' category. Job transfers were less likely to have heard about their current housing situation by seeing a sign on building (a method that would require the renter to be able to physically search for "For Lease" signs in the city to which they are moving. Likewise, renters moving for a job transfer were less likely to have heard about their home through word of mouth because the mover probably knows fewer people in the city to which he is moving.

At this point, a pattern emerges between the active search methods such as advertisements and real estate brokers and passive search methods like signs on a

building and word of mouth. Though neither category of search methods promises higher quality housing, the active search methods generally require more intensive search and suggest movers will be able to find suitable housing in a shorter period of time. From the results, I conclude that higher earning and more educated renters opt for active search methods, while less educated and lower earning renters rely on passive search methods. Likewise, more motivated renters, such as those who were forced to move or were moving for a job, were less likely to use passive search methods and more likely to use active search methods.

Though many of these variables prove to be significant, the low R-squared value and the low predicted probabilities shown in Table 15 indicate that the choice among search methods includes many other factors that are not accounted for in this regression. Table 15 summarizes the predicted probabilities for each search method based on the regression in Table 14. The predicted probabilities for hiring a real estate broker, seeing a sign on a building, or other remain smaller than 20% even at the 75th percentile.

These low predicted probabilities are partially tied to the observed growth of the 'other' category during this time period (see Figure 1). The ambiguity of this response limits how much information can be deduced from the data. By 2013 nearly 1 in 5 renters had found their current housing unit through a method other than advertisements, word of mouth, broker or sign on a building. This indicates that either the range of available search methods for renters is diversifying and expanding, or that renters have become dissatisfied with traditional methods and started searching more creatively. The internet may have had an important role in this diversification as it not only provides websites

specific to housing advertisements, but also connects people through online forums and social networking which they could also use to find housing.

5.2 Search Intensity

The second stage regressions on renter's search intensity are presented in Table 17. Each regression includes the same mover characteristics included in the first stage, interaction terms between the mover characteristics and the dummy variable indicating whether the survey was taken after 2006, year fixed effects and random effects. Apart from regression one which does not correct for selection bias, each following regression is conditional on the specific choice of search method. The regressions in columns 2-6 each correspond to one of the five search options. I originally included MSA fixed effects to control for variations across cities that were constant throughout the time period. However, the results of a Hausman test indicated that the use of random effects was the appropriate model. This indicates that these patterns are homogenous across cities and that renters' search behavior regarding search intensity changed similarly in all metropolitan areas. The time fixed effects are statistically significant for all five regressions and are important for capturing fluctuations in the housing market such as the 2008 crash that affected the country as a whole.

The many differences between regression 1 and the other five regressions reveal that the conditional mean corrections are important for correcting the selection bias produced by the renter's choice of search method. The results reported in column 1 differ greatly from the results of the other regressions confirming that there is significant selection bias and that indeed search intensity is conditional on search method. As an

additional robustness check, I conducted joint chi-squared tests for the conditional mean correction terms in regressions 2-6; the terms were jointly significant in each of the regressions (Table 18).

Contrary to my hypothesis, all renters except those that hired a real estate broker visited fewer homes after 2006. On the one hand, this result was unexpected because it is not consistent with the principle within OST that search intensity increases when the marginal cost of search decreases. This relationship described in OST has been confirmed by other studies such as Zumpano and Richardson (2011) and D'Urso (2002) that found internet search increases search intensity. However, those studies focused solely on homebuyers, the majority of whom hire real estate brokers to assist in their searches. My results indicate that renters who hired real estate brokers were the only group that did not look at fewer homes in their search after 2006 when online housing advertising websites became more widely used. This suggests that my results confirm that the use of real estate brokers paired with searching online results in relatively more intensive searches than other search methods paired with searching on the internet. However, according to these data, only 2% of renters hired real estate brokers to search for housing. Thus renter's search behavior is vastly different than that of homebuyers and was impacted by the internet differently.

The regression results indicate that, conditional on search method, those searching for housing after 2006 reported fewer homes visited during renter's search. It is unclear whether this effect is due to the emergence of online housing websites, as I originally assumed, or if it is a consequence of the burst of the housing bubble burst that occurred simultaneously. See Table 19 for the estimated log-transformed effects on search

intensity after 2006 and the estimated change in average number of homes visited by search method. The effect was the greatest for renters who used signs on buildings as they visited 61% fewer homes in 2006 during their search. After 2006, renters that used word of mouth, the most frequently used search method from 1999-2013, visited 52% fewer homes. These effects are estimated holding all other variables constant. Since there was no drastic reduction in the average number of homes visited during this time period (see Figure 8), the regression results indicate that the demographic characteristics for renters using these search strategies have significantly changed. This demographic transformation has acted as a counterbalance to the estimated decrease in search intensity since 2006.

Without conditioning for which search method was used, renters moving within or into an urban area visited more homes than those moving to rural areas. The significance of moving within or into an urban area only remains given the renter first learns about his housing unit by seeing a sign on a building. This implies that though renters chose their search methods depending on whether they wanted to move into or remain in an urban area as discussed previously, the urban location does not impact the renter's search intensity unless they are primarily looking for housing units by looking for signs advertising open units. Given that a renter first learned about his current unit from seeing a sign on a building, the urban renter visited twice as many units as the rural renter. Renters who see a sign on a building could be more likely to visit the advertised unit at the same time that they noticed the sign. Since urban areas are denser, renters looking to move are more likely to see more "For Lease" signs and then immediately visit those open units.

All regressions indicated that all renters that moved after 2006 into or within urban areas had visited fewer units during their search. Since urban residents dominate the overall sample (Table 11), this reinforces the results previously reported that renters searched less intensively after online housing advertising became popular.

Education is not a significant determinant of search intensity after controlling for the search strategy the renter used. The significance of education for search intensity reported in regression 1 instead captures the relationship between education and search method choice. As mentioned earlier, higher levels of education increases the likelihood that a renter will choose active methods of search such as advertisements or hiring a real estate broker which typically result in more intensive search.

Renter's age exhibits a significant non-linear relationship with search intensity for all renters except those who hired a real estate broker. The results indicate that search intensity increases as age increases at a decreasing rate until reaching a specific peak age. At this point, search intensity begins to decrease as the renter's age increases. Given the use of advertisements, renters older than 46 years old searched less intensively. In comparison, the search intensity of renters who saw a sign on a building or heard about their current home through a friend began to decrease when renters were older than 39 and 36 respectively. These differences imply that the learning effect is stronger for renters who use signs on a building or first heard about their current housing unit through friends.

As expected, higher income renters generally searched more intensively because they experienced higher opportunity costs for prolonging their searches. This relationship was statistically significant given for renters who found their unit from a sign on a

building or heard through a friend; however income was not significant when renters used the more active search methods. This difference indicates that income is more important in the initial choice of search methods. If higher earners do not use more active search methods as expected, then they will make up for this choice by searching more intensively while using the passive search methods. This effect is particularly large for renters that searched using signs on buildings, exhibiting an 18% increase in the number of homes looked at for every 1% increase in income. Across all search methods, the effect of income on search intensity increased by roughly 2% after 2006. For renters that used signs on buildings, this meant that after 2006 renters that earned 1% more income looked at 20% more homes than the lower earning renters. If one renter earned $40,000 a year and different renter with the same characteristics earned $50,000 a year, a 25% increase in income, the higher earning renter looked at 5 more homes than the other renter if he moved after 2006.

Renters who moved for a job transfer looked at fewer units than renters moving for other reasons. This effect was the most pronounced for renters that hired real estate brokers. A renter that hired a real estate broker to move for a job looked at 35% fewer units than renters moving for other reasons that hired brokers. This relationship was unexpected. Renters moving for a job are more likely to move to a new city and consequently face high travel costs as well as high opportunity costs for lengthy searches. The result challenges whether the total number of homes looked at throughout search can be considered to be a valid measure of search intensity.

In contrast, renters that were forced to move and who heard about their current units after seeing a sign on a building or through a friend looked at slightly more units.

Forced moves compel renters to find new units in short periods of time and thus increase how intensively they search. However, this relationship is only significant for passive search strategies because renters that were forced to move were already more likely to choose the active search strategies that result in more intensive searches.

Overall the results present a mixed confirmation of optimal search theory as it is applied to renter's behavior in their search for housing. The estimated relationships between search intensity and the renter's characteristics such as education, age, and income were predicted correctly using the framework of optimal search theory. However, the significant decreases in renters' search intensity after 2006 and the lower search intensity for renters who were moving for a job cannot be explained by the model. These discrepancies challenge my assumption that the total number of homes looked at during search is an accurate measurement of search intensity.

Previous papers such as Richardson and Zumpano (2012) use the average number of homes visited in one week as their measurement for search intensity. This method more closely resembles the definition of search intensity in optimal search theory. AHS did not ask respondents how long they searched for housing and so I did not have the ability to estimate search intensity in this way. The unexpected results force one to consider whether the total number of homes looked at during search is a better measurement for renter's search duration rather than search intensity. However, if I interpret the data in this way, then my results indicate that renter's search duration has decreased after online search became popular among renters. This interpretation similarly challenges the results of several other studies that found the use of the internet increased homebuyer's time spent searching (D'Urso 2002, Richardson and Zumpano 2012,

Genovese and Han 2012). Nonetheless, the finding that, holding other variables constant, all renters except those who hired real estate brokers looked at significantly fewer homes during their search offers important insight into renter's search behavior.

Nonetheless, the reduction in the number of homes visited by renters during this time period can be explained intuitively. As online search allows renters to learn about several units without visiting them, renters can be more selective when choosing which units to physically visit. Thus, renters may visit fewer units because they are able to distinguish which units have the best matching potential via online search. This implies that there has been an increase in the match quality of the visited units.

A major limitation to this investigation is the lack of data on the frequency of renters' online search. Since I do not have data for which renters used online search, I cannot confidently conclude that the reduction in search intensity was caused by the growing popularity of online search. The questionnaire change in 2011 provides information on the percentage of renters who successfully found rental units using housing websites (see Table 13), however this data is only available for two surveys. Furthermore, it is unlikely that renters only used the one method through which they eventually found their current housing unit. Allowing respondents to mark all of the search methods they used in addition to how they first learned about their current housing unit would resolve these limitations.

5.3 Rental Vacancy Rates

The total number of units that are available to rent in the designated search area also impacts renters' search intensity. To better understand how market forces influence

renters' search intensity, I ran a regression using the average number of homes visited

during search for each MSA and each survey as the dependent variable and the MSA

yearly rental vacancy rates as the explanatory variable. Because the survey data refers to

households that moved within the two years before the survey date, I used the rental

vacancy rates from two years prior. For instance, the variation in the average number of

homes visited by renters searching in Chicago in 2011 is explained by the Chicago-wide

rental vacancy rate of 2009. This method avoids problems with explaining average search

intensities using future rental vacancy rates.

        Table 19 shows the results of this regression and a regression including year fixed

effects. Though there is a significant relationship between search intensity and rental

vacancy rates, the coefficient is relatively small at -0.06. For instance if the rental

vacancy rate increases in a metropolitan area by one standard deviation, 3.58 percentage

points, then in that metropolitan area renters will visit 0.22 fewer homes during their

search. This is only a 4% reduction in the average search intensity, 5.3 homes visited, for

renters from 1999-2013.

6. Conclusion

This thesis explored which factors are important in renters' choice of search methods. It explores how renters' search methods and search intensity changed after the emergence of online housing websites. It adds to the literature on housing search and matching models by focusing on renters, a group often ignored in these models, and by using data from the American Housing Survey, an overlooked source of data on renters' and homebuyers' search behaviors. I find that more educated renters, higher earning renters, renters whose move is involuntary, and renters that have limited access to the move destination are all more likely to find housing through active search methods such as advertisements or real estate brokers rather than passive search methods like word of mouth or signs on buildings. Moreover, renters that moved after 2006 visited fewer homes during their search, whatever search method they used, except those hiring real estate brokers.

The results offer insight into what search methods are most successful for different types of renters. After the emergence of online housing advertising platforms, renters became less likely to hire real estate brokers or use signs on buildings. Though advertisements as a whole (print and online combined) did not exhibit any dramatic change throughout the time period, the data from 2011-2013 indicate that on average one in five renters had found housing through searching online, displacing the traditional use of newspaper ads. The growing share of renters using a search method other than advertisements, real estate brokers, friends, or signs on buildings suggests that renters' search methods are diversifying. This expansion of search methods is another potentially overlooked outcome of the internet.

The second stage regression indicates that all renters searching after 2006, except those that used real estate brokers, visited fewer homes than previously. It is unclear whether this result points to a reduction in renters' search intensity, as I originally assumed, or a shorter search duration. Nevertheless, the results are useful in understanding how renters' search efficiency has potentially changed since 2006. However, the cause of this change is ambiguous since the data on internet search in this dataset is limited.

Further research is needed to determine the exact impact of online search on renters' search behavior and search efficiency. As renters' and homebuyers' searches occur more frequently via a computer screen, economists need to consider alternative and more comprehensive measurements of search intensity. One example of such an alternative measurement could be the average time spent searching online per week considered in conjunction with the more traditional measurement of average number of homes visited per week.

Altogether, data on housing search behavior, particularly that of renters, are limited in terms of scope and availability. internet search data offers one promising source for future research; however, these datasets are also limited because they do not identify when a renter or homebuyer successfully finds a new place to live. A combination of internet search data and survey data would provide the best avenue to pursue further research. Finally, as the U.S. rental rate continues to increase, research on renters' search behavior will be increasingly necessary as a way to better understand renters' roles in the housing market and their impact on macroeconomic indicators such as vacancy and unemployment rates.

Appendix: Tables

Table 1: Sample Size and Number of Renters

Year	Total Number of Housing Units Survey	Number of Renters	Renter occupied as % of all units
1999	52,385	16,614	31.72%
2001	47,852	14,371	30.03%
2003	53,826	16,257	30.20%
2005	48,513	14,507	28.30%
2007	45,672	13,352	29.23%
2009	51,524	15,688	30.45%
2011	157,672	56,992	36.15%
2013	71,912	26,744	37.19%

Table 2: Characteristics of all Respondents

	Owner-Occupied				Renter-Occupied			
	mean	sd	min	max	mean	sd	min	max
Age	53.82	15.96	14	93	43.81	17.76	14	93
Education (in years)	13.92	2.87	1	22	13.04	2.98	1	22
Household Income	$78,034.62	$94,713	-$40,616	$9,999,996	$38,052	$51,519	-$40,616	$9,999,996
# persons in household	2.62	1.43	1	20	2.34	1.50	1	17
Observations	296,860				155,558			

Table 3: Characteristics of Recent Movers

	Owner-Occupied				Renter-Occupied			
	mean	sd	min	max	mean	sd	min	max
Age	41.82	13.93	14	93	36.71	14.38	14	93
Education (in years)	14.49	2.66	1	22	13.51	2.72	1	22
Household Income	$85,329	$86,082	-$12,061	$1,918,740	$41,490	$48,044	-$13,488	$1,918,768
# persons in household	2.76	1.44	1	18	2.44	1.46	1	17
# homes looked at	13.93	18.19	0	99	5.31	8.10	0	99
Observations	29,599				60,554			

Table 4: Marital Status and Living Arrangements

	All Respondents		Recent Movers	
	Owner-Occupied	Renter-Occupied	Owner-Occupied	Renter-Occupied
Married, Spouse Present	62.11%	26.72%	60.36%	26.95%
Married, Spouse Absent	1.09%	2.51%	1.54%	2.83%
Widowed	11.78%	8.88%	4.34%	5.07%
Divorced	13.54%	19.28%	14.55%	17.46%
Separated	1.42%	5.66%	1.99%	6.02%
Never Married	10.06%	36.95%	17.22%	41.68%
Live with relatives	74.46%	51.99%	73.83%	53.17%
Live with non-relatives	25.54%	48.01%	26.18%	46.83%

Table 5: Search strategy AHS question

How did you first hear about this unit?	
1999-2009: 1. Advertisements 2. Real Estate Broker 3. Sign on Property 4. Friend 5. Other	2011-2013 (Previous survey category in parenthesis) 1. Word of Mouth (Friend) 2. Daily Newspaper (Advertisement) 3. Weekly Newspaper (Advertisement) 4. Craigslist.com (Advertisement) 5. Realtor.com (Advertisement) 6. Ad on a different internet site (Advertisement) 7. Apartment Rental agency listing (Advertisement) 8. Talking with a real estate agent (Real Estate Broker) 9. Sign on outside of building (Sign on Property) 10. Billboard (Advertisement) 11. Radio ad (Advertisement) 12. Other (Other)

Table 6: Search strategies for homebuyers and renters

How first heard about unit, 1999-2013 averages	Owner-Occupied Market	Renter-Occupied Market
Advertisement	21.60%	28.55%
Real Estate Broker	29.77%	3.55%
Sign on outside of Building	11.68%	12.23%
Word of Mouth	21.60%	39.77%
Other	15.34%	15.91%

Table 7: Renter's income in the previous year in $

Year	Mean	Standard Deviation	Minimum	Maximum	25th p.	Median	75th p	Number of Observations
1999	32,088	33354	-10,000	607,085	12,000	25,000	41,000	14,967
2001	36,631	47020	-10,000	719,444	13,000	26,638	45,000	12,954
2003	37,104	93352	-10,000	9,999,996	13,500	27,000	45,280	14,821
2005	35,340	38812	-40,616	901,528	12,360	26,356	47,000	13,034
2007	38,018	40604	-28,316	802,245	14,000	27,400	50,000	11,715
2009	39,138	40228	-26,976	598,402	14,000	29,000	51,500	14,133
2011	40,574	49618	-129	1,918,768	12,771	27,100	52,744	50,577
2013	38,677	46769	-65	730,873	10,900	24,987	49,988	23,358

Table 8: Renter's age

Year	Mean	Standard Deviation	Minimum	Maximum	25th p.	Median	75th p.	Number of Observations
1999	41.91	17.16	15	93	29	38	51	14,967
2001	41.57	17.26	15	93	28	38	51	12,954
2003	42.37	17.19	14	93	29	39	52	14,821
2005	43.20	18.12	14	92	29	39	53	13,034
2007	43.75	18.30	16	93	29	40	55	11,715
2009	44.07	17.94	15	93	30	40	55	14,133
2011	44.15	17.45	14	93	30	41	55	50,577
2013	46.69	18.40	13	93	31	44	59	23,358

Table 9: Renter's educational attainment (in years of education)

Year	Mean	Standard Deviation	Minimum	Maximum	25th p.	Median	75th p.	Number of Observations
1999	13.18	2.84	1	22	12	14	14	7379
2001	13.17	2.77	1	22	12	14	14	6225
2003	13.15	2.83	1	22	12	14	14	6758
2005	13.17	2.85	1	22	12	14	14	6604
2007	13.18	2.85	1	22	12	14	14	5729
2009	13.35	2.71	1	22	12	14	14	6948
2011	13.57	2.73	1	22	12	14	16	24531
2013	13.48	2.76	1	22	12	14	16	9879

Table 10: Number of homes visited in the search process by renters

Year	Mean	Standard Deviation	Minimum	Maximum	25th p.	Median	75th p.	Number of Observations
1999	4.87	7.51	0	99	1	3	5	6,223
2001	5.10	8.20	0	99	1	3	6	5,358
2003	5.27	8.68	0	99	1	3	6	5,695
2005	4.92	7.75	0	99	1	3	5	5,474
2007	5.18	7.72	0	99	1	3	6	4,484
2009	5.57	8.47	0	99	2	3	6	5,514
2011	5.56	8.21	0	99	2	3	6	20,165
2013	5.32	7.91	0	99	2	3	6	7,642

Table 11: Moving Variables, Percent of Renters

Variables:	Percent of Renters
Moved for a job transfer	10.32%
Forced move	15.77%
Moved to or within urban Area	89.7%

Table 12: Reasons for Moving AHS Questions

Question: What are the reasons you moved from your last residence?	Recoded as a Forced Move
For less expensive rent/maintenance	No
To own not rent or vice versa	No
To be closer to work/school/other	No
Because unit was going condo/co-op	Yes
Because of disaster loss	Yes
Eviction	Yes
For other family/personal reasons	No
For other financial/employment reasons	No
For foreclosure reasons	Yes
Because government using land/unit	Yes
Force to move by government	Yes
For other housing related reasons	No
For new job or job transfer	Yes
Because needed larger unit	No
Because of marital status change	No
Because unit was condemned	Yes
To establish own household	No
For some other reason	No
Because owner taking over unit	Yes
Because private company/person wants unit	Yes
To obtain higher quality unit	No
Because unit closed for repairs	Yes

Table 12: Correlations

	Number of units looked at	Income	Education	Age	Job Transfer	Forced to Move	Urban
Number of units looked at	1						
Income	0.0671	1					
Education	0.0901	0.2789	1				
Age	-0.0213	-0.0167	-0.1099	1			
Job Transfer	0.0262	0.1136	0.1893	-0.153	1		
Forced to Move	0.0594	0.1283	0.1520	-0.435	0.738	1	
Urban	0.0221	0.0100	0.0347	-0.0160	-0.0145	-0.0167	1
Advertisements	0.0986	0.0975	0.1564	-0.0907	0.0813	0.0699	0.0257
Broker	0.0648	0.0909	0.0797	-0.0045	0.0650	0.0582	0.0049
Sign on Property	0.0401	-0.0042	-0.0343	-0.0204	-0.0217	-0.0167	0.0295
Friend	-0.1294	-0.0964	-0.1341	0.04	-0.0725	-0.0688	-0.0624
Other	-0.0268	-0.0337	-0.0232	0.0791	-0.0169	-0.0088	0.0227

Table 13: 2011-2013 Search strategies

	Owners % using strategy		Renters % using strategy	
Year	**2011**	**2013**	**2011**	**2013**
Word of Mouth	15.51	18.22	36.02	39.76
Advertisements:	3.72	3.23	9.75	9.82
Daily Newspaper	1.74	1.44	4.39	4.1
Weekly Newspaper	0.66	0.62	1.75	1.48
Radio Ad	0.38	0.39	0.34	0.24
Billboard	0.09	0.03	0.04	0.11
Apartment Rental Agency Listing	0.85	0.75	3.23	3.89
internet Ads:	30.91	31.8	21.25	19.6
Craigslist	1.97	1.18	12.39	9.8
Realtor.com	18.95	20.39	2.27	2.68
Ad on a different website	9.99	10.23	6.59	7.12
Talking with a real estate agent	24.95	21.89	2.01	2.35
Sign on building	6.25	5.54	12.2	8.99
Other	18.65	19.31	18.76	19.49

Table 14: Multinomial Logit Regression Results

VARIABLES	(1) Advertisements	(2) Broker	(3) Sign on Building	(4) Friend
After06	-0.426***	-1.409***	-0.742***	-0.499***
	(0.0514)	(0.0946)	(0.0637)	(0.0484)
Urban	-0.0284	0.0786	0.193***	-0.347***
	(0.0418)	(0.0765)	(0.0520)	(0.0381)
Education	0.0872***	0.128***	-0.0313***	-0.0394***
	(0.00472)	(0.00894)	(0.00545)	(0.00425)
Age	0.00346	0.0386***	0.0478***	-0.0111***
	(0.00392)	(0.00811)	(0.00503)	(0.00337)
Age squared	-0.00025***	-0.00049***	-0.00069***	3.91e-05
	(4.16e-05)	(8.84e-05)	(5.50e-05)	(3.42e-05)
Log Income	0.198***	0.419***	0.149***	0.0342***
	(0.0112)	(0.0258)	(0.0136)	(0.00975)
Job Transfer	0.168***	0.372***	-0.125	-0.0454
	(0.0617)	(0.105)	(0.0770)	(0.0607)
Forced Move	-0.00976	0.118	-0.0973	-0.184***
	(0.0510)	(0.0926)	(0.0615)	(0.0485)
Constant	-2.055***	-7.623***	-1.892***	2.108***
	(0.145)	(0.303)	(0.178)	(0.130)
Observations	71,456	71,456	71,456	71,456
Year FE	YES	YES	YES	YES
Pseudo R2	0.0317	0.0317	0.0317	0.0317

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 15: Predicted Probabilities from Table 14 Regression Results

Predicted Probabilities	Mean	Min	25th Percentile	Median	75th Percentile	Max	Observations
Advertisements	0.29	0.01	0.23	0.28	0.34	0.64	71,456
Broker	0.04	0	0.02	0.03	0.05	0.36	71,456
Sign on Building	0.12	0.01	0.1	0.12	0.14	0.24	71,456
Friend	0.4	0.1	0.34	0.4	0.45	0.75	71,456
Other	0.16	0.05	0.12	0.15	0.18	0.42	71,456

Table 16: Average marginal effects on search strategy used from multinomial-logit regression in Table 14

	Advertisements	Broker	Sign	Friend	Other
After06	0.008	-.0272***	-.0357***	-.0179*	.0726***
Urban	.0295***	.0056***	.0361***	-.0920***	.0207***
Age	0.000	.0010***	.0055***	-.0059***	-0.001
Age Sq	-.00003***	-9.48e-06***	-.00007***	.00008***	.00002***
Log Income	.0277***	.0091***	.0061***	-.0268***	-.0160***
Education	.0223***	.0034***	-.0049***	-.0194***	-.0013*
Job Transfer	.0412***	.0112***	-.0181**	-.0296**	-0.005
Forced Move	.0214**	.0061*	-0.002	-.0394***	.0136*
*** p<0.01, ** p<0.05, * p<0.1					

Table 17: Regime Switching Regression Results: Search Intensity (# of units visited)

Search Method Correction:	(1) No Correction	(2) Ads	(3) Broker	(4) Sign	(5) Friend	(6) Other
VARIABLES	Log(SI)	Log(SI)	Log(SI)	Log(SI)	Log(SI)	Log(SI)
After06	-0.105	-0.461***	0.314	-0.954***	-0.459***	-0.735*
	(0.0788)	(0.162)	(0.545)	(0.241)	(0.171)	(0.388)
Urban	0.0779***	0.00177	-0.111	0.711***	0.131	-0.0440
	(0.00796)	(0.108)	(0.158)	(0.198)	(0.0996)	(0.162)
AfterUrban	-0.0411***	-0.0437***	-0.0476***	-0.0460***	-0.0434***	-0.0365**
	(0.0149)	(0.0154)	(0.0160)	(0.0161)	(0.0157)	(0.0147)
Educ	0.0350***	-0.0590	-0.102	-0.0351	0.00789	-0.000943
	(0.00297)	(0.0511)	(0.0796)	(0.0227)	(0.0222)	(0.0189)
AfterEduc	-0.00134	0.00229	0.00105	0.00253	0.00257	0.00222
	(0.00283)	(0.00330)	(0.00329)	(0.00330)	(0.00328)	(0.00328)
Age	0.0112***	0.0215***	-0.00578	0.105***	0.0270***	0.0215***
	(0.00325)	(0.00684)	(0.0237)	(0.0258)	(0.00643)	(0.00583)
Age squared	-0.000153***	-0.000232*	-4.42e-05	-0.00132***	-0.000369***	-0.000377***
	(3.41e-05)	(0.000129)	(0.000249)	(0.000326)	(8.34e-05)	(9.79e-05)
Age_After06	0.00334	0.00210	0.00178	0.00147	0.00208	0.00230
	(0.00234)	(0.00243)	(0.00237)	(0.00234)	(0.00241)	(0.00243)
Age_Sq_After06	-2.77e-05	-1.75e-05	-1.52e-05	-1.21e-05	-1.75e-05	-1.45e-05
	(2.35e-05)	(2.42e-05)	(2.38e-05)	(2.36e-05)	(2.41e-05)	(2.40e-05)
Log Income	0.0284***	-0.0316	-0.213	0.180***	0.0593*	0.102*
	(0.00701)	(0.0771)	(0.203)	(0.0558)	(0.0321)	(0.0611)
Log Income_ After06	0.0105	0.0191***	0.0177***	0.0195***	0.0193***	0.0155**
	(0.00682)	(0.00687)	(0.00683)	(0.00681)	(0.00685)	(0.00693)
Job Transfer	-0.0756**	-0.257**	-0.435**	-0.338***	-0.139***	-0.145***
	(0.0296)	(0.107)	(0.221)	(0.0768)	(0.0530)	(0.0499)
JobTransfer_After06	-0.0169	0.000302	-0.00249	-0.00561	-4.69e-05	-0.00238
	(0.0468)	(0.0468)	(0.0461)	(0.0459)	(0.0463)	(0.0460)
Forced Move	0.158***	0.0295	-0.0908	0.119***	0.107**	0.0120
	(0.0305)	(0.0588)	(0.131)	(0.0406)	(0.0532)	(0.0982)
Forced Move_After06	-0.00607	-0.00432	-0.00777	-0.00607	-0.00407	0.000827
	(0.0420)	(0.0413)	(0.0421)	(0.0419)	(0.0416)	(0.0410)
2001year	0.0226	0.0277	0.110	-0.133***	-0.0105	-0.0335
	(0.0147)	(0.0313)	(0.0899)	(0.0465)	(0.0183)	(0.0353)
2003year	0.00908	0.0597	0.182	0.0690**	0.00968	-0.0600
	(0.0151)	(0.0533)	(0.139)	(0.0322)	(0.0314)	(0.0765)
2005year	-0.00348	0.119	0.202	0.210***	0.0278	-0.0658
	(0.0164)	(0.0834)	(0.143)	(0.0661)	(0.0368)	(0.0926)
2007year	-0.0203	0.290***	-0.258	0.873***	0.227**	0.412*
	(0.0175)	(0.104)	(0.391)	(0.246)	(0.105)	(0.243)
2009year	0.0121	0.340***	-0.341	0.977***	0.272***	0.458*

	(0.0193)	(0.106)	(0.479)	(0.264)	(0.105)	(0.247)
2011year	0.00922	0.0810***	0.254**	0.557***	0.116***	0.0964***
	(0.0137)	(0.0312)	(0.109)	(0.145)	(0.0326)	(0.0283)
Constant	0.0393***	3.835	9.141	-12.48***	-0.386	3.527
	(-0.0866)	(3.045)	(6.908)	(3.282)	(0.401)	(3.288)
Observations	48,487	48,487	48,487	48,487	48,487	48,487
Number of MSAs	148	148	148	148	148	148
Random Effects	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 17: Chi-squared tests for significance of conditional mean correction terms

	chi-squared (5restr.)	Prob > chi2
Regression 2	47.33	0.0000
Regression 3	46.98	0.0000
Regression 4	37.72	0.0000
Regression 5	47.87	0.0000
Regression 6	46.85	0.0000

Table 18: Search intensity after 2006

	(II) Advertisements	(III) Broker	(IV) Sign	(V) Friend	(VI) Other
Estimated coefficients (from Table 16)	-0.461***	0.314	-0.954***	-0.459***	-0.735***
Transformed coeff. ((exp^coeff.)-1)	-0.369	N/A	-0.615	-0.368	-0.520
Average number of units visited, 1999-2013	6.49	7.91	6.14	3.94	4.78
Change in average number of homes visited after 2006, (according to estimated coeff. in Table 16)	-2.39	N/A	-3.78	-1.45	-2.49

Table 19: Rental Vacancy Rates

VARIABLES	(1) Average Number of Homes Visited	(2) Average Number of Homes Visited
Rental Vacancy Rates	-0.0610***	-0.0618**
	(0.0233)	(0.0242)
Constant	5.821***	5.465***
	(0.237)	(0.291)
Year Fixed Effects	No	Yes
Observations	397	397
R-squared	0.017	0.043
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Appendix: Figures

Figure 1: Renter's search strategies, 1999-2013
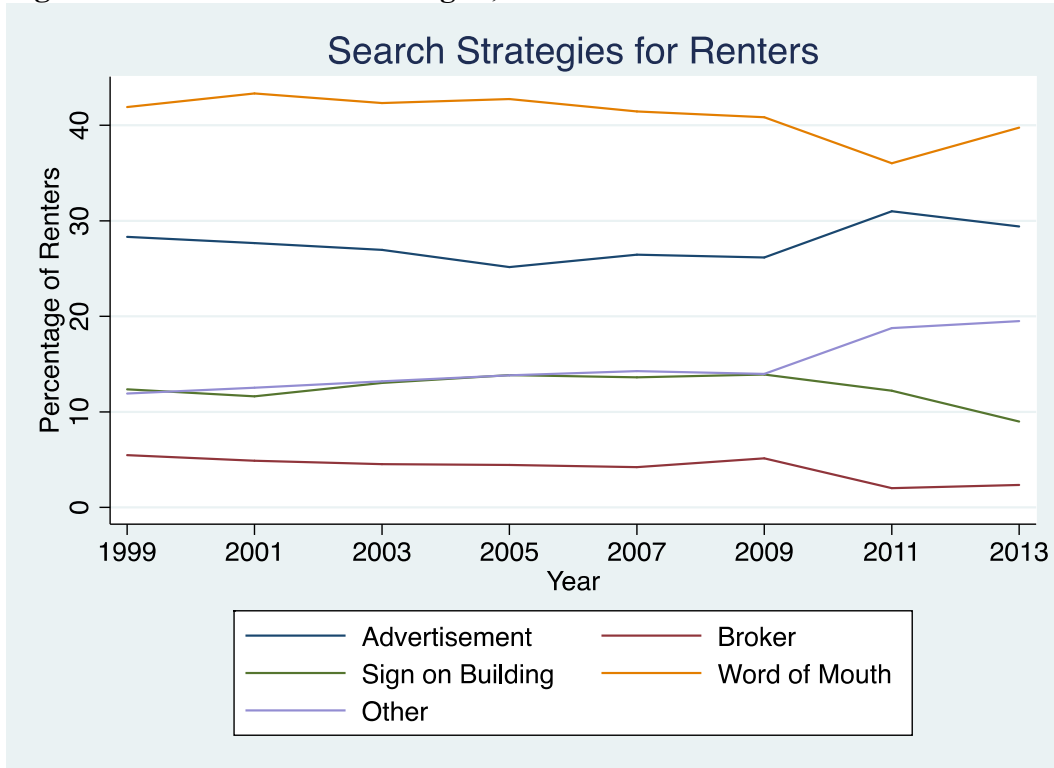
Figure 2: Buyer's search strategies, 1999-2013
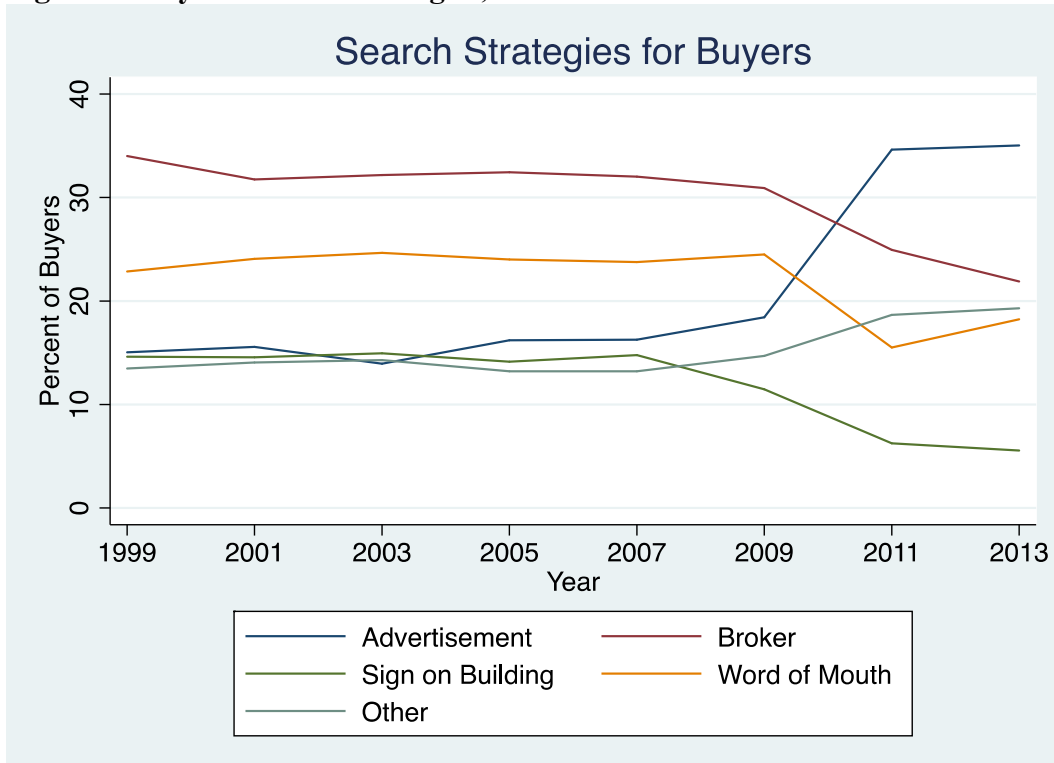
Figure 3: Renter's search strategies: Rural vs. Urban, 1999-2013
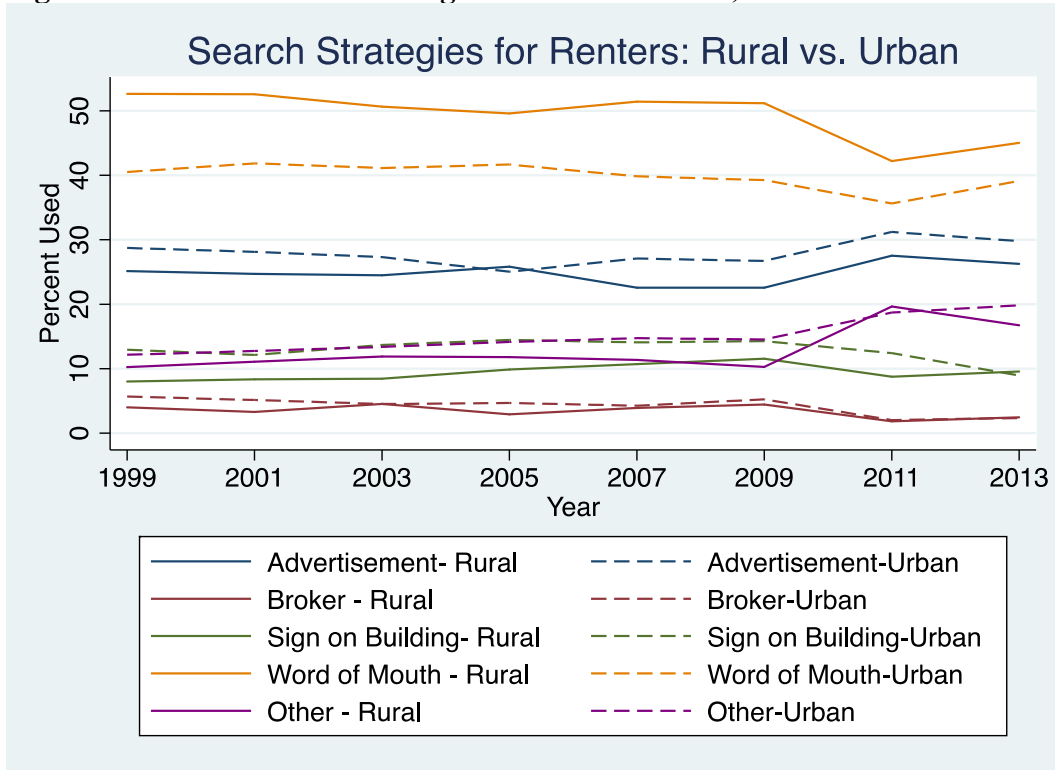
Figure 4: Box & whisker plots of renter's income by search strategy, 1999-2013
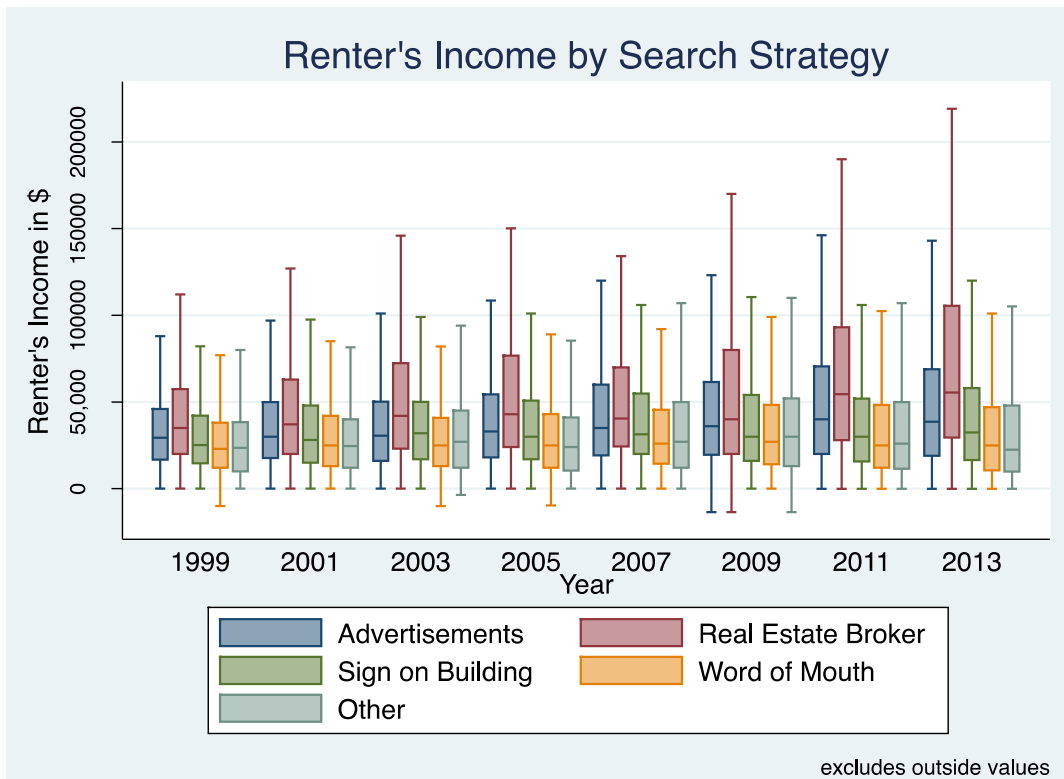
Figure 5: Box & whisker plots of renter's age by search strategy, 1999-2013

Renter's Age by Search Strategy

excludes outside values
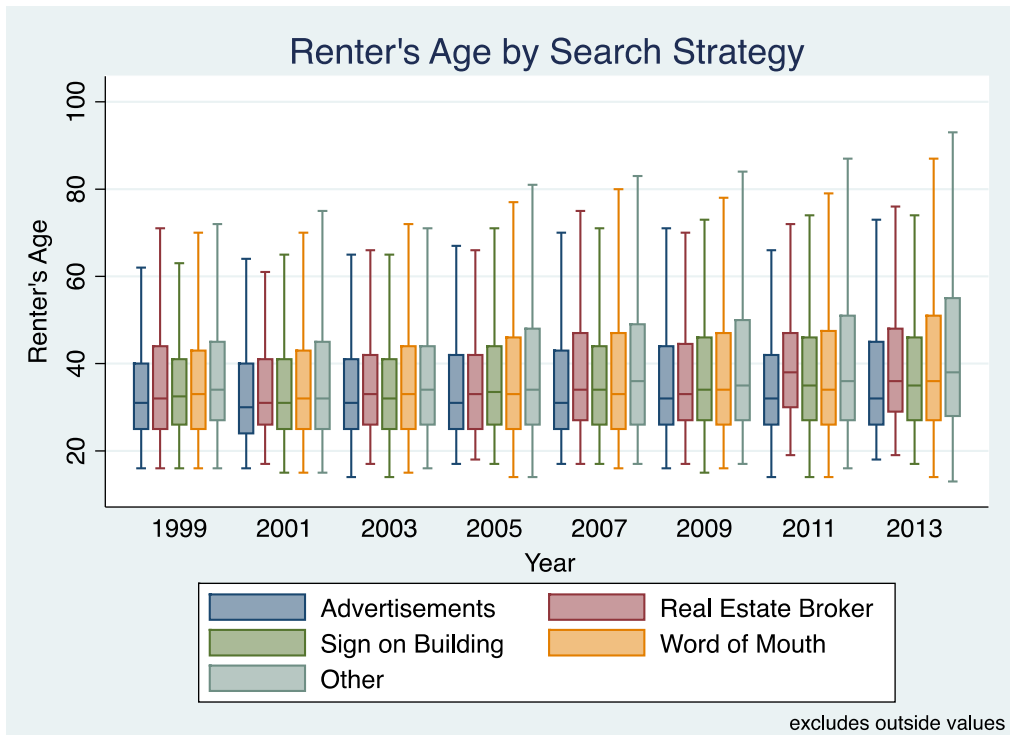
Figure 6: Box & whisker plots of renter's education by search strategy, 1999-2013

Renter's Educational Attainment by Search Strategy

excludes outside values
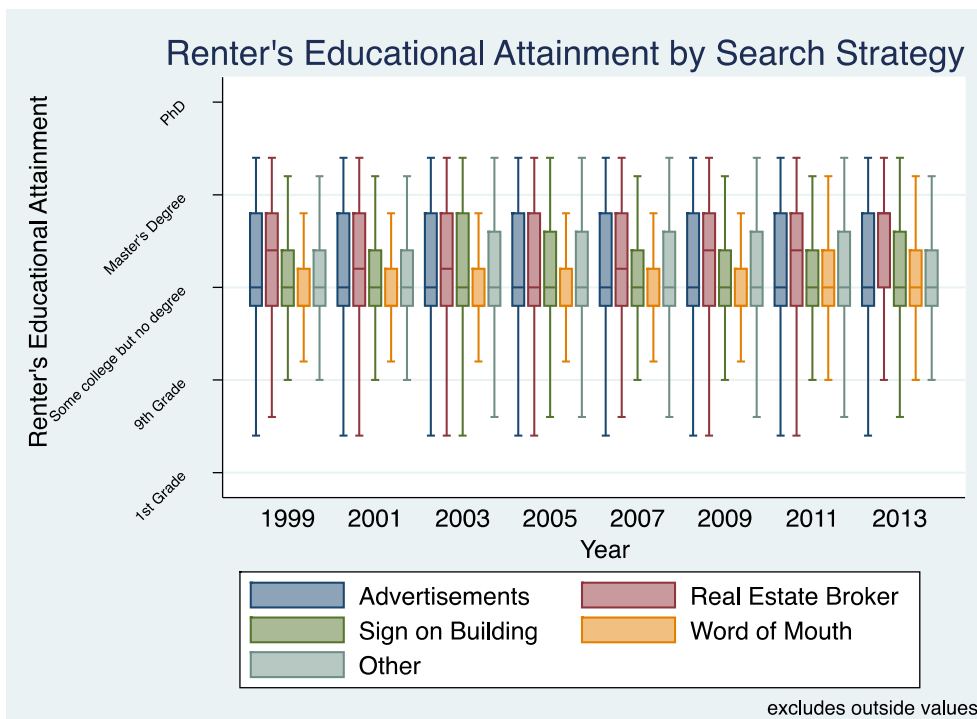
Figure 7: Box & whisker plots of renter's income by search strategy, 2011-2013
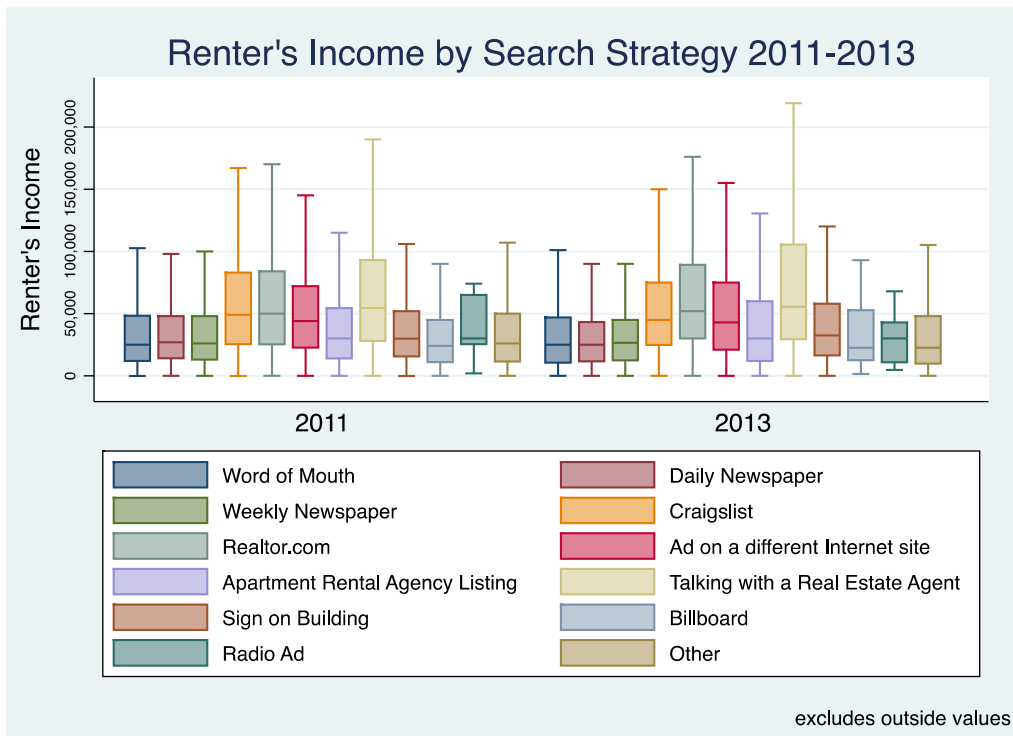
Figure 8: Renters' average search intensity by search strategy, 1999-2013
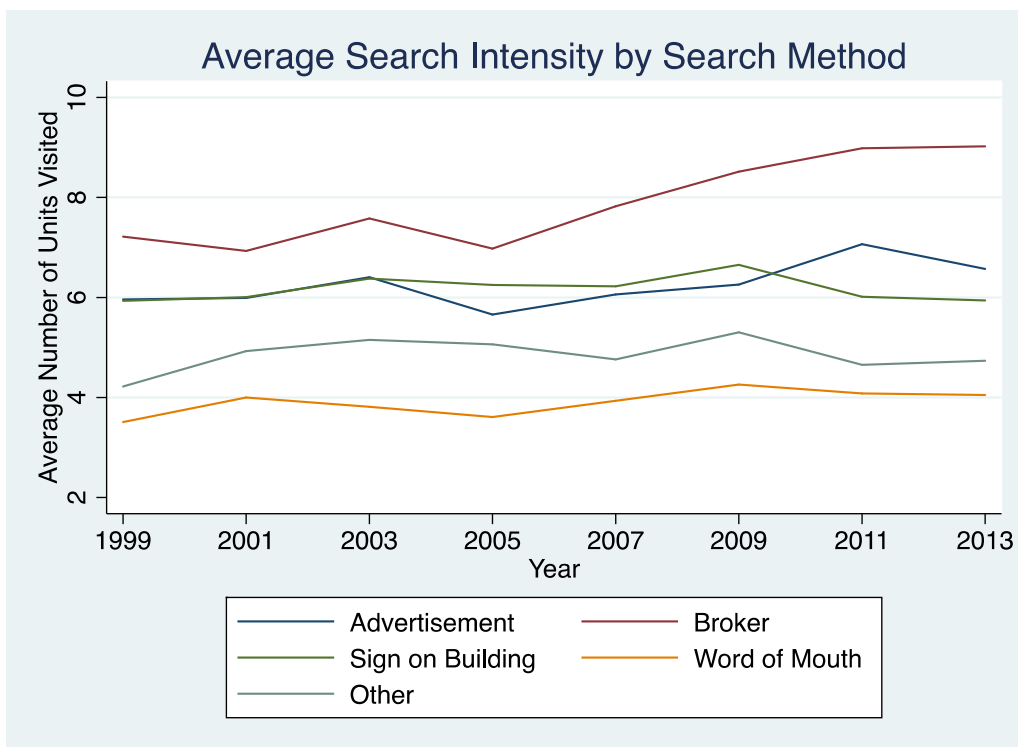
Figure 9: Box & whisker plots of renter's search intensity by search strategy, 1999-2013
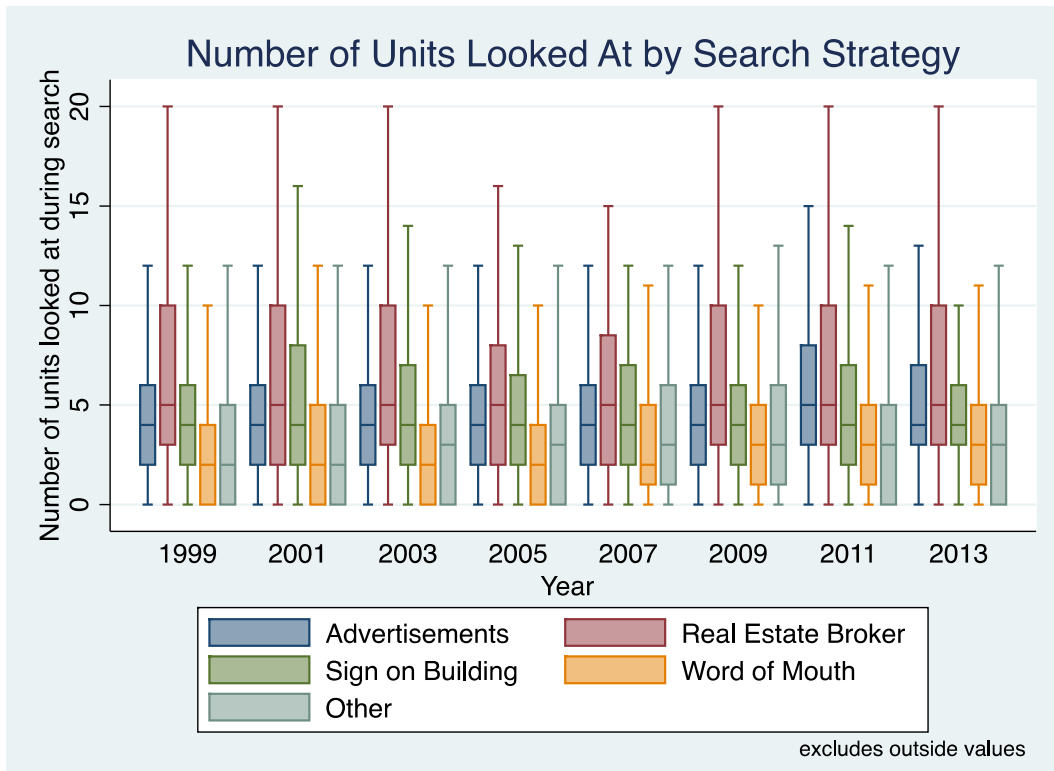
Figure 10: Homebuyer's Search Trends, 2001-2016

WHERE BUYER FOUND THE HOME THEY PURCHASED, 2001-2016
(Percentage Distribution)

Legend:
- Internet
- Real estate agent
- Yard sign/open house sign
- Friend, relative or neighbor
- Home builder or their agent
- Directly from sellers/Knew the sellers
- Print newspaper advertisement
- Home book or magazine
- Other
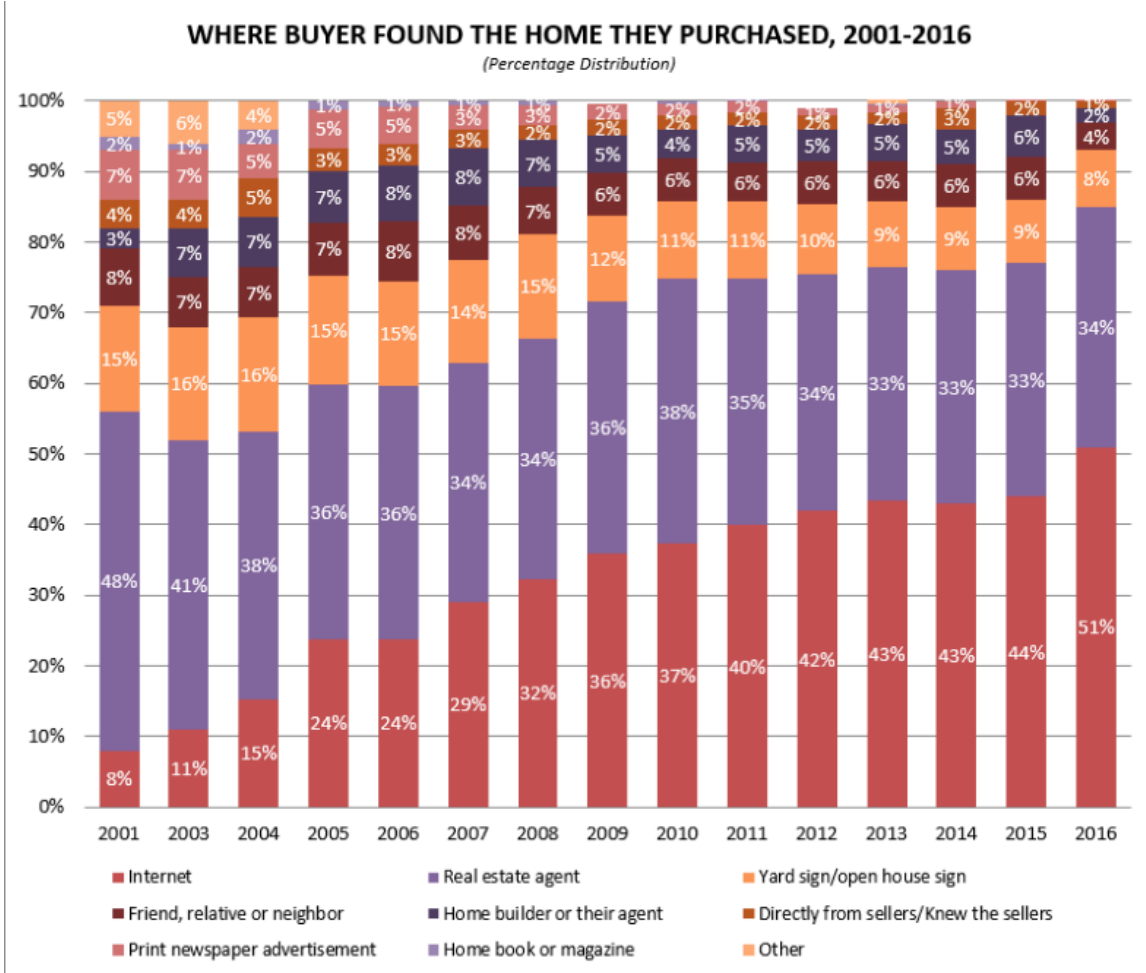
Source: "Home Buyers: Search Online For A Home, Close With An Agent" Riggs, 2016

Figure 11: Craigslist Boston
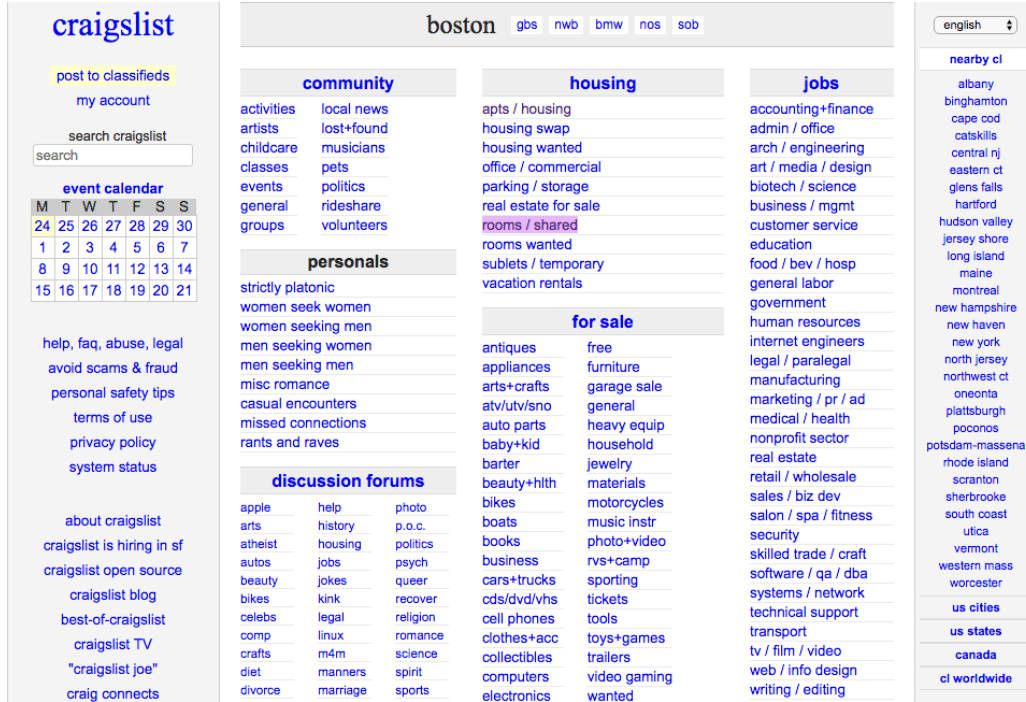
Source: https://boston.craigslist.org/ visited 4/24/2017

**Figure 12: Craigslist Boston Apartments**
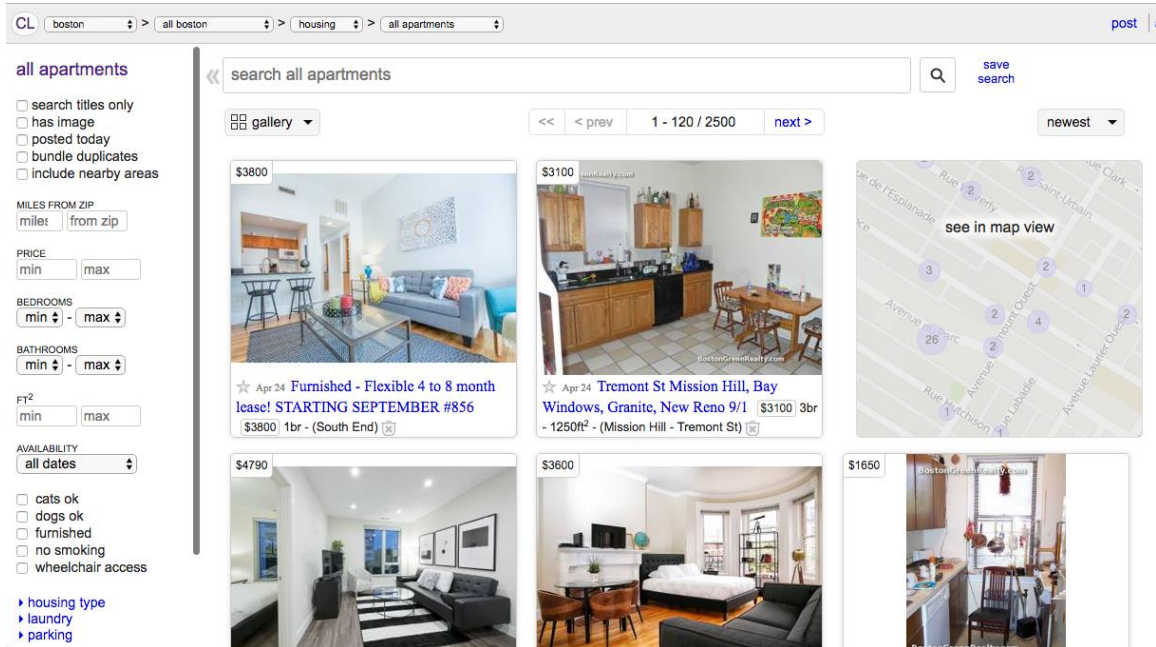
Source: https://boston.craigslist.org/search/aap visited 4/24/2017

Figure 13: Realtor.com
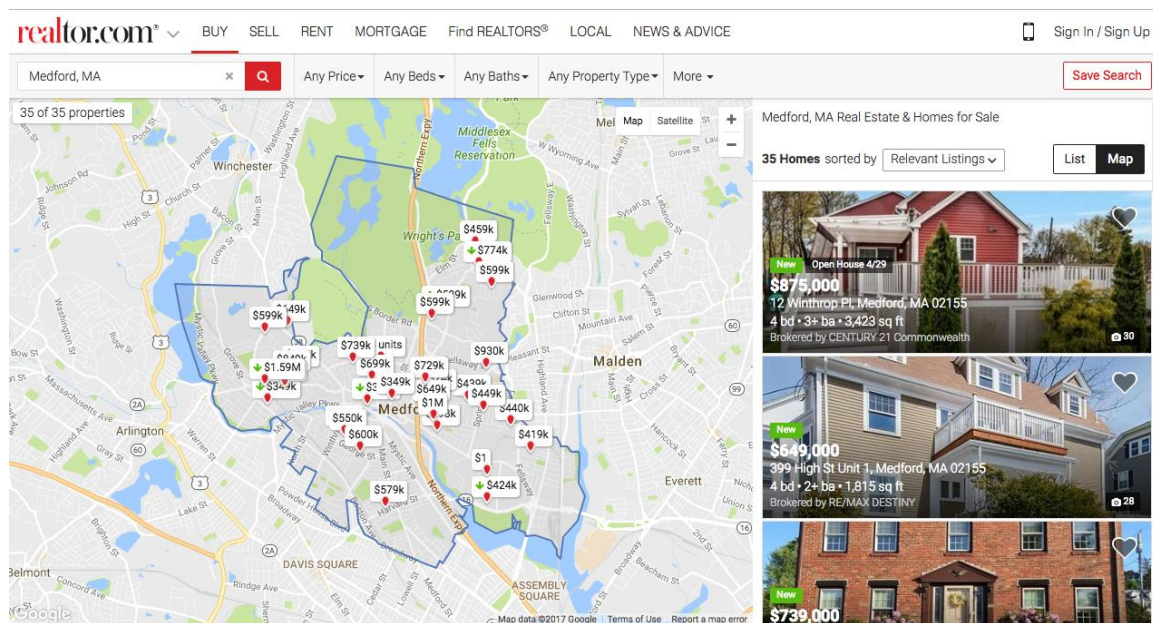
Source: http://www.realtor.com/realestateandhomes-search/Medford_MA visited 4/24/2017

Figure 14: Zillow
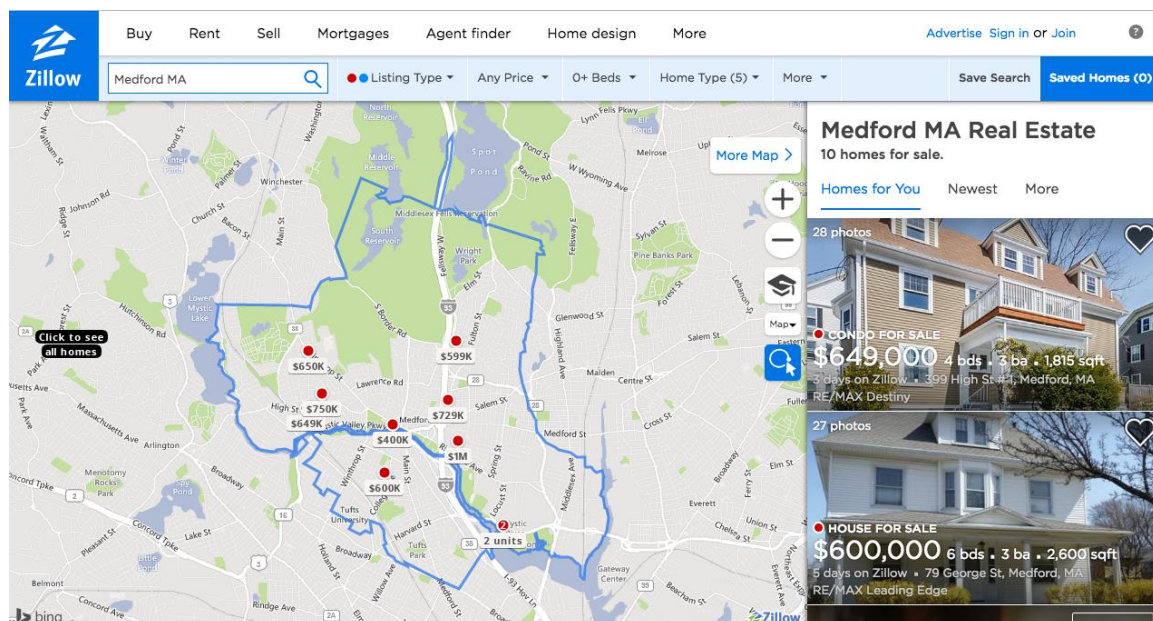
Source: https://www.zillow.com/homes/1_ah/Medford-MA_rb/?fromHomePage=true&shouldFireSellPageImplicitClaimGA=false&fromHomePageTab=zestimate&view=owner visited 4/24/2017

Figure 15: Trulia

Source: https://www.trulia.com/MA/Medford/ visited 4/24/2017

Figure 16: Redfin

Source: https://www.redfin.com/city/10142/MA/Medford visited 4/24/2017

Figure 17: Computer and internet Access at Home, 1997-2012, CPS data

Computer and Internet Use at Home, 1997-2012

% of Households

Internet Access at Home   Computer Access at Home
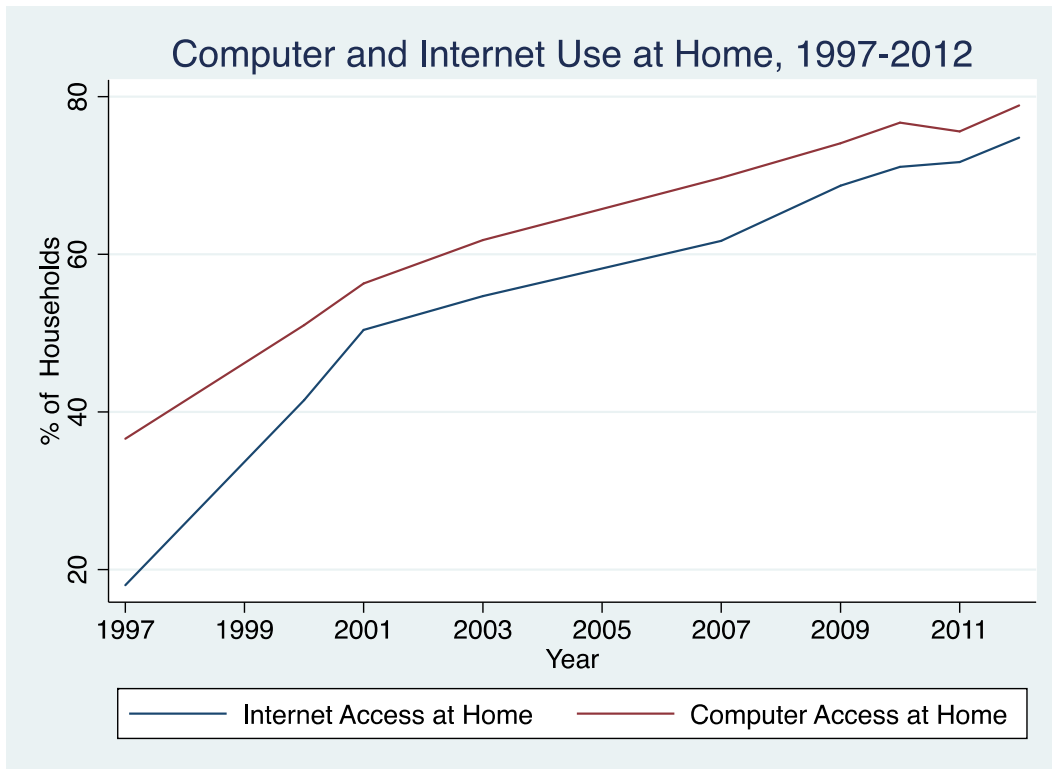
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